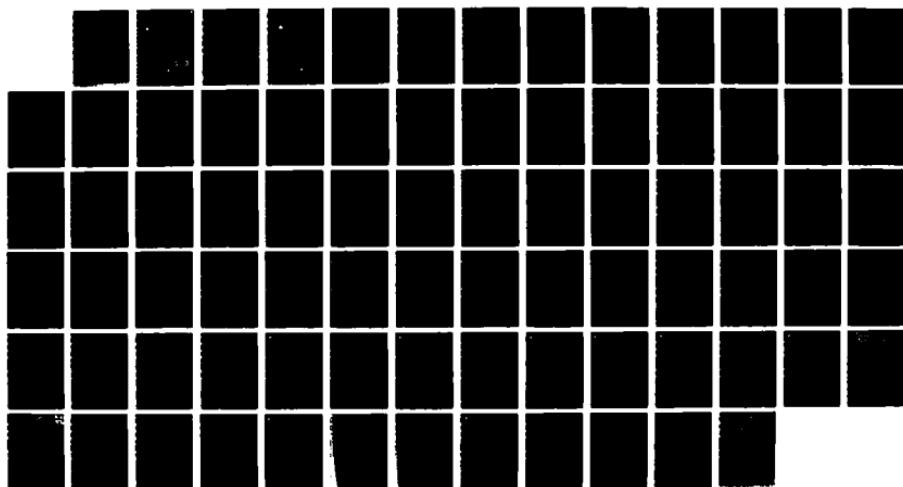


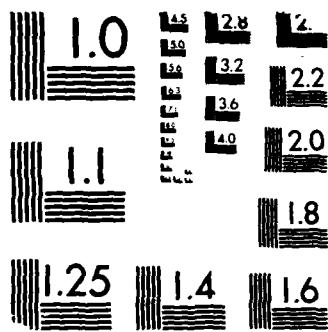
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Waste Minimization Program Air Force Plant 59

AD-A191 834

Prepared for:

U.S. Air Force System Command
Aeronautical Systems Division/PMD
Wright-Patterson, AFB, OH 45433
Contract - F09603-84-G-1462-SC01

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Waste Minimization Program

Air Force Plant 59

Prepared for:

**U.S. Air Force System Command
Aeronautical Systems Division/PMD
Wright-Patterson, AFB, OH 45433
Contract - F09603-84-G-1462-SC01**

 **The Earth Technology
Corporation**

**300 N. Washington St.
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February 1986

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1.0 INTRODUCTION

This report presents the findings of an assessment of waste minimization opportunities at Air Force Plant 59 in Binghamton, New York. It is part of the Waste Minimization Program being conducted by the Air Force Systems Command, Aeronautical Systems Division/Facilities Management Division (ASD/PMD) for eight (8) Government-Owned, Contractor-Operated (GOCO) facilities to promote prudent waste management by exploiting opportunities to limit land disposal, reduce costs and conserve resources.

A project team completed a site investigation of General Electric Company operations during the week of June 24, 1985 to review facility operations and discuss opportunities for waste reduction with plant engineering staffs. Based upon this investigation and subsequent analyses, this report presents the status of current waste generation and minimization programs and recommends other potential methods for reducing current waste volumes. Tables of waste volumes before and after minimization have been prepared to provide an indication of planned and projected waste reduction through system modifications. Finally, recommendations for implementation of opportunities which could further reduce waste generation and disposal are provided.

1.1 BACKGROUND

Interest in waste minimization has long been promoted by Federal legislation such as the Federal Water Pollution Control Act Amendments of 1972, the Energy Policy and Conservation Act of 1975 and the Used Oil Recycling Act as well as DOD directives such as AFR 78-22 and DODD 19-14. More recently, the impetus for waste minimization has become even stronger. The reauthorization of RCRA includes bans on landfilling of certain waste types and a request for certification that waste minimization is being conducted by hazardous waste generators. Similarly, DOD has issued directives requiring zero land disposal of solvents by October, 1986 through its Used Solvent Elimination Program.

ASD/PMD anticipated these developments and initiated programs in 1983 to address these issues. A preliminary identification of resource conservation and recovery activities and opportunities was included in an environmental audit program conducted in 1983 for fifteen (15) facilities. ASD/PMD contracted a further study of resource conservation and recovery opportunities at eleven (11) GOCO facilities in 1984. This effort resulted in a preliminary assessment of opportunities for industrial and non-industrial (i.e., solid or municipal) waste streams.

The methodology for this effort relied primarily on data acquired during the environmental audit program conducted in 1983 supplemented with conversations and information exchanges between the study team and GOCO contractor personnel. The results of this investigation were an indication of the areas where resource conservation and recovery opportunities appeared to be most substantial, and the areas where opportunities were not promising. Through application of a consistent methodology, facilities with substantial opportunities and measures warranting further investigation were identified.

The 1984 study demonstrated that plant operators were implementing methods that could substantially reduce waste generation volumes and raw material requirements to reduce their waste management costs and potential liabilities associated with waste land disposal. However, other opportunities for waste minimization were identified which appeared both technically and economically feasible, but were not being implemented.

In light of the findings of these studies and the new certification requirements of RCRA, ASD/PMD is adopting a Waste Minimization Program. This program is promoting prudent waste management by exploiting opportunities to reduce costs and conserve resources. It is intended to establish for ASD/PMD the status of progress in this area, and to demonstrate facility advances in alternate waste management methods. In addition, it is expected that new opportunities determined to be infeasible in the past will be identified for possible implementation.

1.2 OBJECTIVES

The ASD/PMD Waste Minimization Program is designed to promote waste management opportunities which reduce the reliance on land disposal by GOCO facilities and which result in increased efficiency in the utilization of resources. As part of this program, this study has the following objectives:

1. Define the status of waste generation and existing minimization concepts at AFP 59.
2. Support feasible alternatives identified at AFP 59 by General Electric.
3. Identify and evaluate new opportunities not being implemented at AFP 59.
4. Stimulate technology transfer between AFP 59 and other Air Force GOCO facilities as well as with other DOD installations.

5. Continue to increase the awareness of the importance of waste minimization.
6. Provide information needed to confidently certify that waste minimization is being employed at AFP 59 to satisfy RCRA requirements and DOD directives.

2.0 CONCLUSIONS AND RECOMMENDATIONS

Air Force Plant 59, located in Johnson City, New York, is operated by the General Electric Company (GE). AFP 59 encompasses 29.5 acres with most operations located in a single manufacturing building and several structures covering over 600 thousand square feet of building space. GE currently employs approximately 2,300 personnel operating on 3 shifts. Primary activities at AFP 59 include manufacture and assembly of aircraft electronic equipment including flight control systems, fire control systems, internal navigation and guidance systems, and aerospace ground support equipment. GE operations are part of F-4, F-5E, F-5G, F-15, F-18, F-104, F-105, F-111, B-1, A-10A, C-5A, C-130, C-141, B-52, Vulcan Air Defense and several aerospace defense programs. A limited amount (less than 5 percent) of commercial work is also performed at AFP 59 by GE.

As a result of manufacturing operations at AFP 59, GE generated small amounts of waste that required treatment or disposal. In 1984, GE generated a total of 492,000 lb (56,600 gal) of waste that was transported off-site. In addition, GE treated and discharged approximately 67.6 million lb (8.1 million gal) of plating rinsewater in 1984. Incorporation of a new ion exchange system has reduced this waste discharge to 2.1 million lb (250,000 gal), but has resulted in an additional 510,000 lb (60,000 gal) of regeneration wastes requiring off-site treatment. GE does not dispose of any wastes off-site; off-site management is limited to recycle, fuel blending and treatment. The total estimated cost of waste management in 1984 is \$64,790. Measures such as the ion exchange system and other modifications planned by GE will reduce total waste generation at AFP 59 and help to avoid potential liabilities associated with off-site management.

A summary of the conclusions, recommendations and economics resulting from an investigation of waste minimization opportunities at GE is provided below.

2.1 CONCLUSIONS

This section presents a summary of the waste minimization measures being incorporated by GE, as well as alternatives being considered as part of waste minimization initiatives at AFP 59 and alternatives requiring further investigation, development or capital resources prior to incorporation.

A summary of 1984 waste generation and disposal volumes, currently planned reductions, and additional potential reductions being considered by GE is provided in Table 2-1. A brief description of reduction methods is provided in Table 2-2. An analysis of these data results in the following conclusions:

1. GE currently has in-place measures to minimize the generation of the following wastes:
 1. 1,1,1-Trichloroethane vapor degreasing wastes are recovered on-site in a central distillation unit, reducing waste generation by 68 percent.
 2. On-site plating rinsewater is recovered through ion exchange and recycle to plating rinse tanks. A 97 percent reduction in rinsewater usage has been obtained.

In addition, GE has virtually eliminated direct disposal of wastes at off-site facilities. All other wastes generated by GE and managed by an off-site TSD facility are fuel blended for incineration, or treated to destroy or remove hazardous constituents. Waste disposal is now limited to the indirect disposal of treatment sludges by GE's off-site TSD facilities. These off-site management methods, if conducted soundly, are considered to pose the least liability and demonstrate a true commitment to avoiding land disposal. Therefore, additional opportunities are limited to reducing reliance on off-site treatment facilities and providing maximum use of valuable resources, through source reductions.

2. Additional waste minimization efforts planned by GE include:
 1. Freon vapor degreasing solvent recovery through on-site distillation, resulting in additional reductions of 12 percent of current off-site management levels.
 2. Reduction of cyanide plating operations to reduce cyanide waste generation as much as possible.
 3. Improvements of the ion exchange recovery system to reduce rinsewater overflow and regeneration/backwash waste volumes.

TABLE 2-1
AFP 59: GENERAL ELECTRIC
PROJECTED WASTE DISPOSAL

| WASTE STREAM | 1984 GENERATION (POUNDS) | 1984 LAND DISPOSAL (POUNDS) | PROJECTED GENERATION W/PLANNED MINIMIZATION (POUNDS) | PROJECTED GENERATION W/PROPOSED MINIMIZATION (POUNDS) |
|------------------------------------|--------------------------------|-----------------------------------|--|---|
| 1. Mixed Chlorinated Solvent Waste | 42,000 | - | 35,000 | 0 |
| 2. Mixed Flammable Solvent Waste | 2,000 | - | 2,000 | 300 |
| 3. Paint/Laquer Waste | 8,000 | - | 8,000 | 4,600 |
| 4. Coolant Waste | 100,000 | - | 100,000 | 1,300 |
| 5. Cyanide Plating Bath Waste | 2,000 | - | 2,000 | 0 |
| 6. Acid Plating Bath Waste | 338,000 | - | 338,000 | 338,000 |
| 7. Plating Rinse-water | 67.6×10^6 | - | 2.08×10^6 | 0 |
| 8. Ion Exchange System Waste | - | - | $510,000^1$ | 108,000 |
| TOTAL | 68.1×10^6 | 0 | 3.1×10^6 | 0.45×10^6 |
| % REDUCTION | - | | 95% | 99% |

¹Waste generation is the result of ion exchange system for recovery of plating rinsewaters.

NOTE: No wastes generated by GE are currently (or planned to be) directly land disposed. Off-site management consists of incineration, fuel blending and treatment. This table therefore presents source reductions directed at minimizing waste management requirements.

TABLE 2-2
 AFP 59: GENERAL ELECTRIC
 SUMMARY OF CURRENT, PLANNED
 AND PROPOSED WASTE MANAGEMENT
 METHODS

| WASTE STREAM | PRESENT METHOD | PLANNED CHANGES | PROPOSED CHANGES |
|------------------------------------|---|------------------------------------|---|
| 1. Mixed Chlorinated Solvent Waste | On-site recovery; fuel blending/ incineration | Increased recovery | Off-site recovery of solvents not recovered on-site |
| 2. Mixed Flammable Solvent Waste | Fuel blending/ None incineration | | On-site recovery |
| 3. Paint/Laquer Waste | Fuel blending/ None incineration | | On-site recovery |
| 4. Coolant Waste | Separation; oils to fuel blending | None | On-site recovery; oils to fuel blending |
| 5. Cyanide Plating Bath Waste | Off-site treatment | Reduction of use | Elimination |
| 6. Acid Plating Bath Waste | Off-site treatment | None | Off-site reclamation |
| 7. Plating Rinse-water | On-site treatment | Ion exchange ¹ recovery | Reduced floor washing and rinse flow |
| 8. Ion Exchange System Waste | - | None | Reduction through segregation and reuse. |

¹Began operation in late 1984

3. Incorporation of an ion exchange system for recovery of plating rinsewaters has proven to be effective in reducing rinsewater discharge volumes by 97 percent and achieving SPDES discharge limitations. However, operation to date has shown:
 1. Significant overflow (250,000 gal/yr) of deionized water from the system due to input of floor washings to the ion exchange system.
 2. Generation of 60,000 gal/yr of waste from resin backwash and regeneration increasing off-site treatment costs by \$28,100.

Reduction in these two waste streams can substantially improve system economics and further reduce the total volume of wastes leaving the facility by an estimated 78 percent of current levels.
4. Additional opportunities identified for minimization of wastes generated at AFP 59 include:
 1. Off-site recovery of waste chlorinated solvents, not currently planned for on-site recovery, can virtually eliminate off-site waste solvent management.
 2. On-site recovery of solvents from mixed flammable solvent and paint/laquer wastes (now fuel blended off-site) will reduce waste volumes by 51 percent of current levels.
 3. On-site recovery of machine coolant will eliminate off-site treatment of the water component of waste coolants. Reductions of 98 percent are possible.
 4. Sale of segregated plating bath solutions to off-site recovery companies is possible to reduce current treatment requirements.
 5. Reduction in rinsewater flow rates and associated ion exchange backwash volumes can result in a 78 percent reduction of current regenerant waste disposed off-site and may eliminate rinsewater overflow.

Each of these opportunities have merit for providing further reductions in current waste generation and can provide savings over current waste management practices.

2.2 RECOMMENDATIONS

Based on the findings of this waste minimization investigation of AFP 59, the following is an inventory of recommendations made with the objective of minimizing current waste management.

1. Mixed Chlorinated Solvent Waste

1. Investigate the cause of failure of recovered Chlorothene VG solvents.
2. Test vapor degreasing solvent upgrading with additive materials.
3. Install a recovery unit for Freon vapor degreasing solvent recovery.
4. Recover chlorinated solvents not planned for on-site recovery through an off-site facility.

2. Mixed Flammable Solvent Waste

1. Investigate recovery of solvents for reuse in paint booth clean-up operations.

3. Paint/Lacquer Waste

1. Install a solvent recovery work station for solvent recovery and reuse in paint booth operations.
2. Investigate reuse of mixed flammable solvents in paint booth clean-up operations.
3. Institute a routine solvent recovery program to ensure effective operation of the recovery unit.

4. Coolant Waste

1. Investigate options for coolant recovery for reuse in machining operations.
2. Purchase the most cost-effective recovery system.
3. Use bactericide additives for recovered coolants to achieve greatest useful coolant life.

4. Recover coolant on a routine schedule to minimize coolant degradation.

5. Use deionized water for coolant make-up to reduce mineral build-up and extend coolant life.

5. Cyanide Plating Bath Waste

1. Investigate changeover to non-cyanide cadmium and copper plating operations.

6. Acid Plating Bath Waste

1. Investigate off-site recovery of plating baths, to reduce treatment requirements and achieve economic benefits.

7. Plating Rinsewater

1. Investigate alternative rinse tank arrangements including countercurrent multiple tank rinsing, consolidation of rinse tanks and reactive rinsing.

2. Install flow restrictors and air agitation on all rinse tanks to reduce flow for same plate quality.

3. Minimize floor washings to reduce excess water input to rinsewater recycle system.

8. Ion Exchange System Waste

1. Collect and segregate ion exchange backwash rinsewater for mixing with plating room rinsewaters, and reuse in other operations such as regeneration chemical make-up, plating bath make-up or floor washdown.

2. Decrease frequency of anion exchange resin regeneration from current frequency of 13 times per year to 2-3 times per year; regeneration of cation resins should continue on current frequency.

3. Investigate reduction of floor washings to ion exchange system to eliminate high-level contaminants from plugging resins.

2.3 ECONOMICS

Table 2-3 summarizes the economics of recommended waste minimization alternatives developed through this investigation. Economics are order of magnitude estimates only and should not be used in place of detailed engineering estimates which consider contractor labor, engineering and administration costs, and facility specific costs. Where costs were not available from GE, estimates are based on standard cost references, vendor quotes or experience with similar capital projects.

TABLE 2-3
APP 59: GENERAL ELECTRIC
POTENTIAL WASTE MINIMIZATION ECONOMICS

| WASTE | OPTION | CAPITAL COST (\$) | ANNUAL O&M COST (\$) | INCREASED ANNUAL SAVINGS (\$) | PAYOUT (YRS) |
|------------------------------------|---|-------------------|----------------------|-------------------------------|---------------|
| 1. Mixed Chlorinated Solvent Waste | 1. Freon recovery | 40,000 | 100 | 5,400 | 7.5 |
| | 2. Off-site recovery | 0 | 0 | 9,500 | 0 |
| 2. Paint/Lacquer Waste | On-site recovery | 6,000 | 200 | 2,800 | 2.2 |
| 3. Mixed Flammable Solvent Waste | On-site recovery with Paint/lacquer waste | 6,000 | 200 | 4,500 | 1.3 |
| 4. Coolant Waste | 1. On-site recovery 2. On-site centrifugation | 10,000 50,000 | 600 600 | 9,100 9,100 | 1.1 5.5 |
| 5. Ion Exchange System Waste | 1. Collection and reuse of rinses in plating line 2. Collection and treat in ion exchange system 3. Reduce anion regeneration | 500 2,000 0 | 0 0 0 | 18,500 18,500 18,500 | <1 <1 0 |

3.0 WASTE MINIMIZATION PROGRAM AFP 59: GENERAL ELECTRIC

This section provides a description of current waste generation and management practices by waste stream at AFP 59 - General Electric. A summary of these current practices is provided in Table 3-1. The following subsections present detailed descriptions of each waste stream and current management methods; waste stream material balances (where appropriate); opportunities for waste minimization; system economics; and recommendations for system implementation. This information is provided in support of the conclusions and recommendations provided in Section 2. Work sheets providing additional information for each waste stream are included in Appendix B.

3.1 MIXED CHLORINATED SOLVENT WASTE

3.1.1 Waste Description and Management Practices

A mixture of chlorinated solvent wastes is generated by GE from three major sources:

1. Waste Chlorothene VG (1,1,1-trichloroethane), trichloroethylene (TCE) and Freons from vapor degreasers.
2. Waste sludges from 1,1,1-trichloroethane degreaser solvent recovery still.
3. Waste Freon from component hand-applied cleaning operations.

Wastes from these sources are consolidated into 55-gallon drums for off-site management.

The major source of chlorinated solvent wastes at GE is vapor degreasing operations. GE operates 23 degreasers of varying size. An inventory of vapor degreasers at AFP 59 is provided in Table 3-2. Degreasers are operated until solvents fail pH, specific gravity or clarity tests conducted on a weekly basis by GE. Freon and TCE solvents are removed from degreaser units and placed directly into drums for disposal. Waste 1,1,1-trichloroethane is collected in drums and transported to the solvent recovery still located in Area 804. Recovered solvent is tested and, if it meets specifications, is reused in degreasing operations. When recovered 1,1,1-trichloroethane does not meet specifications, it is drummed for disposal. GE estimates that approximately one-third of recovered solvent is discarded as waste because it does not meet test specifications.

TABLE 3-1
AFP 59: GENERAL ELECTRIC
WASTE GENERATION RATES AND MANAGEMENT PRACTICES

| WASTE | SOURCE/CONTENT | 1984 GENERATION RATE (POUNDS) | CURRENT MANAGEMENT PRACTICES | | CURRENT COSTS ¹ | CHANGES PROJECTED/COMMENTS |
|------------------------------------|---|-------------------------------------|--|----------------------|-------------------------------|--|
| | | | 1984 GENERATION RATE | CURRENT PRACTICES | | |
| 1. Mixed Chlorinated Solvent Waste | Vapor degreasing, solvent recovery and hand cleaning: -TCE, TCA, Freons -Solids -Oils | 42,000 (3,500 gal) | Collected in drums Drum transport. Fuel blending by Frontier | \$6,400 | | Replacement of TCE with 1,1,1-trichloroethane by 9/85. Requested funding for Freon recovery still for FY 87. |
| 2. Mixed Flammable Solvent Waste | Hand cleaning: -Acetone, toluene, alcohols -Dirt -Oil | 2,000 (290 gal) | Collected in drums Drum transport. Fuel blending by Frontier | \$ 240 | None | |
| 3. Paint/Laquer Waste | Paint thinning and booth clean-up; -MEK, xylene, toluene -Paint solids | 8,000 (800 gal) | Collected in drums Drum transport. Fuel blending by Frontier | \$1,560 | None | |
| 4. Coolant Waste | Machining operations: -95% Water -5% Trimsol coolant -Oils & solids | 100,000 (12,000 gal) | Pumped from machines to portable cart Bulk storage and transport Treatment by Speedy Oil: Oils to fuels blending Water to POTW | \$3,000 | | Gradual reduction in coolant usage |
| 5. Cyanide Plating Bath Waste | Cadmium, and copper and cyanide plating: -Water -Cd, Cu, ions -NaOH, Na ₂ CO ₃ , CN ⁻ | 2,000 (235 gal) | Pumped from plating tanks to drums Drum transport Treatment by Frontier | \$ 390 | | Gradual elimination of cyanide plating operations |

¹ Unit costs are provided in Appendix A.

TABLE 3-1
APP 59: GENERAL ELECTRIC
WASTE GENERATION RATES AND MANAGEMENT PRACTICES

| WASTE | SOURCE/CONTENT | GENERATION DATE | CURRENT MANAGEMENT PRACTICES | CURRENT COSTS ¹ | CHANGES PROJECTED/COMMENTS |
|------------------------------|--|---|---|----------------------------|---|
| 6. Acid Plating Bath Waste | Plating operations: -Water -Cr(III), Cr(VI) -Other metals and ions | 1984 (39,800 gal) | Pumped from tanks to storage tank Bulk transport Treatment by Waste Conversion | \$18,700 | Will include ion exchange regeneration and backwash waste (see Waste #8). |
| 7. Plating Rinse-water | Rinse operations: -Water -Low level ionic contamination | 67.6x10 ⁶ (8.1x10 ⁶ gal) | Collected in storage tank Treated in IX System Deionized water recycled to rinse operations | \$12,000 | Includes cost of discharge of 250,000 gal deionized water from system |
| 8. Ion Exchange System Waste | Ion exchange backwash and regeneration: -Water -Salts and Ions -H ₂ SO ₄ and NaOH | 510,000 (60,000 gal) | Collected in acid waste storage tank Bulk transport Treatment by Waste Conversion | \$28,100 | Expect decreased quantity |

¹ Unit costs are provided in Appendix A.

TABLE 3-2
AFP 59 VAPOR DEGREASER INVENTORY

| LOCATION | SOLVENT | GE ID # |
|-------------------------------------|--------------------------------|---------|
| F39 Wire Assembly | Freon TE | 83172 |
| F31 Wire Assembly | Freon TE | 35552 |
| F31 Wire Assembly | Chlorothene VG | 82139 |
| G26 Site Assembly | Freon TF | 78117 |
| F20 Sensor Assembly | Freon TF | 82410 |
| F26 Sensor Assembly (Clean Room) | Freon TF | 79183 |
| F26 Motor Room (Clean Room) | Freon TF | 83173 |
| D4 Kitting Area | Chlorothene VG | 35554 |
| D47 PWB Lab | Trichloroethylene ¹ | 81629 |
| Plating Room | Freon TE | ? |
| Plating Room | Chlorothene VG | ? |
| Plating Room | Chlorothene VG | 36301 |
| F18 VCSF | Freon TE | 79830 |
| Photoetch | Chlorothene VG | 37993 |
| A8 Tumble Area | Chlorothene VG | 78120 |
| Lap & Hone | Chlorothene VG | 80110 |
| A39 JNAC | Freon TF | ? |
| A39 JNAC | Chlorothene VG | 35658 |
| Hydraulics | Freon TF | 56799 |
| C9 Small Part Assembly | Freon TE | 78118 |
| G28 Board Room | Chlorothene VG ² | 37042 |
| G31 Board Room | Freon TMS | 79130 |
| G31 Con. Coat | Freon TMS | 35201 |
| G31 Con. Coat | Not in Use | 82168 |

1 TCE will be changed to Chlorothene VG in 10/85.

2 Degreaser is equipped with dedicated recovery still.

Note: All degreasers are equipped with manual covers and water separation units. Some are also equipped with air vent systems to reduce organic vapor concentrations in work areas.

In addition to these off-specification solvents generated from degreasing operations, solvent sludges are produced from the recovery operation. Still sludges consisting of solids, oils and 1,1,1,-trichloroethane are collected in drums with other chlorinated solvent waste for off-site disposal.

The third source of chlorinated solvent waste is hand-applied cleaning operations located throughout the plant. Clean-up solvents are distributed in small plastic bottles for use at bench work stations. Waste solvents from cleaning operations are collected in five-gallon safety cans. On a regular basis these waste solvents and empty bottles are collected and waste solvent is consolidated with other chlorinated solvent wastes for off-site disposal.

The total volume of chlorinated solvent waste from these three sources in 1984 was 42,000 lb (approximately 3,500 gal). Waste solvent consists of a mixture of 1,1,1-trichloroethane, TCE, Freons, oils, and solids (e.g. metal fines, dirt, etc.) in varying concentrations. This waste is transported to Frontier Chemical Waste Processing, Inc. located in Niagara Falls, NY for fuel blending. Some of these wastes are then incinerated in Canadian cement kiln systems. Costs for disposal in 1984 were \$6,400 based upon unit costs of \$78/drum for disposal and \$12.70/drum for transportation.

A material balance of solvent use at AFP 59 is provided in Table 3-3. This balance is based on 1984 solvent purchase and waste disposal records with estimates for other solvent fates derived from operational experience and vendor specifications.

3.1.2 Waste Minimization Opportunities

GE has an active solvent recovery program that has been effective in maintaining low volumes of waste solvent disposal. Using on-site distillative recovery, GE is extending the life of 1,1,1-trichloroethane vapor degreasing solvent by as much as three times its normal life without deleterious impacts on part quality. GE has recently requested an additional recovery still to enable Freon solvent recovery from Freon waste streams. GE's current recovery system, the proposed Freon recovery system, and additional waste minimization opportunities are discussed below.

3.1.2.1 Existing Solvent Recovery System

GE has operated a distillative recovery unit since 1978 for recovery of 1,1,1-trichloroethane (currently using Chlorothene VG) vapor degreasing solvent. The system was obtained from Lenape Equipment Inc. of Plainfield, NJ (Catalog #37089, Type: BR-3, Serial No. 577) for \$3,500. Capacity of the unit is 55 gallons of processed solvent per eight hours of operation.

TABLE 3-3
APP 59: CHLORINATED SOLVENT USE
MATERIAL BALANCE

| SOLVENT | ANNUAL USE | | LOSSES | |
|-------------------|---------------------------|------------------------|--------------------|--------------------|
| | VAPOR DEGREASING (GAL) | HAND CLEANING (GAL) | WASTE (GAL) | EMISSIONS (GAL) |
| Trichloroethylene | 500 | 0 | 300 | 200 |
| Chlorothene VG | 7000 | 0 | 2,600 | 4,400 |
| Freon TMS | 55 | 0 | 25 | 30 |
| Freon TE 385 | 200 | 185 | 100 | 285 |
| Freon TF 1650 | 650 | 1,000 | 300 | 1,350 |
| TOTAL | 8,400 | 1,200 | 3,300 ¹ | 6,300 |

¹Difference between estimated (3,300 gal) and manifested mixed chlorinated solvent waste (3,500 gal) is due to contaminants present in waste stream (5% oils, water, solids).

GE tests vapor degreasers on a regular basis to assess solvent quality. Testing involves a pH, visual clarity and specific gravity analysis (0.005 variance on sp gr considered unacceptable). When a degreaser solvent fails any of these tests it is pumped from the degreaser by portable vacuum unit and transferred to Area 804 for recovery. Solvents are pumped from this unit through the solvent recovery still; recovered solvent is collected in a clean solvent drum and wastes are collected in a waste drum for eventual disposal as a hazardous waste. Recovered solvent is again tested and if it meets GE specifications, it is reused in degreasing operations.

Based upon operational history, GE estimates that one of every three recovered solvent batches does not meet specifications and must be discarded as waste. A flow diagram showing annual solvent flows for the recovery unit is provided in Figure 3-1. As shown, solvent usage is reduced from approximately 10,100 gal/yr to current levels of 2,600 gal/yr (75 percent reduction). Based upon these estimates and economic data for new solvents, waste disposal and system operation and maintenance, GE's solvent recovery unit had a payback period of less than one year. A summary of this economic analysis is shown in Table 3-4.

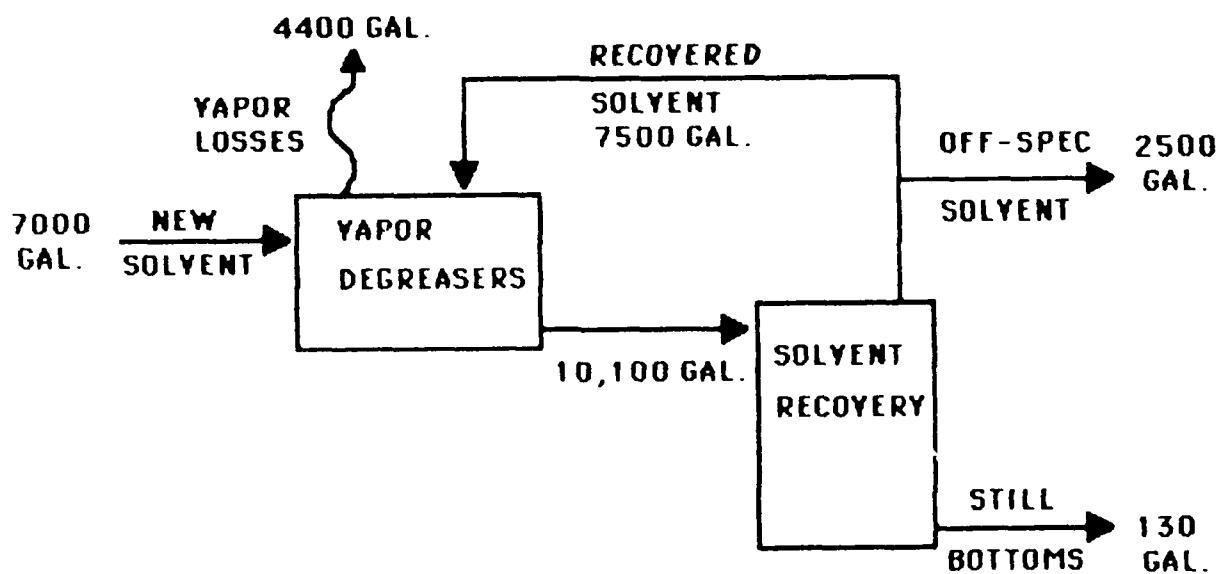
GE has demonstrated successful use of the vapor degreasing solvent recovery unit for over 7 years. Based upon this operational history, the following major findings were noted by GE:

1. Solvents can be recycled to meet operational specifications 67 percent of the time.
2. No deleterious effects on part quality have been experienced as a result of the solvent recovery program.
3. Operation and maintenance requirements of the unit are minimal.
4. Results of the solvent recovery program are sufficiently promising to warrant a request for another unit for Freon solvent recovery.

3.1.2.2 Proposed Freon Recovery System

Based on the promising results of the Chlorothene VG recovery system, GE has requested funding for a second unit for recovery of Freon from other degreasing units. This request was for \$40,000 from FY87 funding. As shown, the proposed system is capable of recovering 400 gal of Freon from degreaser solvent wastes resulting in a net payback of 7.4 years. Based upon this analysis and the reduced reliance on off-site waste management, the proposed project appears to warrant implementation. A summary of the economic analysis is provided in Table 3-4.

FIGURE 3-1
AFP 59 CHLOROTHENE VG
RECOVERY SYSTEM



1. New solvent volume from annual use records
2. Off-spec solvent volume calculated from material balance on solvent use (see Table 3-3)
3. Still bottoms estimated as 5% of total processed solvents.
4. Recovered solvent/off-spec solvent ratio (i.e. 7500 gal/2500 gal) is based on operational history.
5. Other numbers calculated by difference or summation.

TABLE 3-4
ECONOMIC ANALYSIS OF SOLVENT RECOVERY OPTIONS

| ALTERNATIVE | WASTE REDUCTION (GAL/YR) | CAPITAL COST (\$) | AVOIDED O&M COST (\$/YR) | NET SAVINGS (\$/YR) | PAYBACK PERIOD (YRS) |
|---|-----------------------------|-------------------------|-----------------------------------|---------------------------|----------------------------|
| 1. Existing Chlor- othene VG Recovery Still | 7,500 | 3,500 | 51,900 ¹ | 1,500 | 50,400 |
| 2. Proposed Freon Recovery System | 400 | 40,000 | 5,500 ² | 1,002 | 5,400 |
| 3. Off-Site Recovery of Solvent Waste | 3500 | 0 | 9500 ³ | 0 | 9,500 |
| | | | | | Immediate |

1. Based on new solvent costs of \$5.10/gallon and disposal costs of \$90.70/drum.

2. Based on O&M costs of \$0.20/gallon.

3. Based on new solvent costs of \$12.00/gallon and disposal costs of \$94.70/drum.

4. Based on net revenues of \$0.90/gal and avoided disposal costs of \$6,400.

3.1.2.3 Additional Recovery Opportunity

GE currently disposes of approximately 3500 gal/yr of chlorinated solvent waste at a cost of \$6,400. With implementation of the Freon recovery unit, waste disposal will be reduced to 3100 gal/yr. Waste solvents not recovered on-site can often be sold to an off-site recycler for recovery. Typically, net revenues from sale of quality solvent wastes can be expected to range from \$0.90/gal to \$1.25/gal. At a GE waste generation volume of 3500 gal/yr (assuming all waste is shipped off-site pending the on-site Freon recovery unit), revenues of \$3,150 to \$4,380 may be possible. Additional savings may be realized through avoided disposal costs. Currently, GE is paying \$6,400/yr for waste disposal. Thus, total savings of over \$9,500 may be possible through off-site recycling. A summary of the economics of off-site recycling of waste solvents is presented in Table 3-4.

The feasibility of off-site recovery of solvents generated by GE will depend on the following factors:

1. Quality of waste solvents (i.e. level of contaminants).
2. Ability to segregate solvents if required by solvent recovery facility (a mixture of chlorinated solvents with no non-chlorinated solvents may be acceptable to off-site recovery facilities).
3. Volume of waste solvents available per shipment to meet recycler requirements.

These factors will impact the economics of solvent recovery. Nonetheless, recovery of solvent by a reputable solvent recovery facility is generally feasible and can reduce potential liabilities associated with conventional disposal methods.

3.1.3 Recommendations

GE recognizes that expansion of their current solvent recovery program can further reduce volumes of chlorinated solvents requiring disposal. Based upon analyses presented in previous sections, the following recommendations are made:

1. GE should investigate why some recovered solvent batches fail testing. Failure may be caused by introduction of contaminants to solvents prior to or following recovery (i.e., use of dirty drums).

Improved control of waste collection or recovered solvents coupled with reprocessing of off-specification recovered solvent may further reduce current levels of waste disposal.

Problems may also be associated with depletion of acid acceptors in solvents. Several kits are currently available for upgrading 1,1,1-trichloroethane solvent to meet degreasing specifications enabling longer useful lives.

2. Funding should be approved for a Freon recovery unit. Economics of the proposed unit are favorable and reduction in waste volumes is significant enough to warrant funding.
3. GE should investigate off-site recovery of waste chlorinated solvents that can not be recovered further on-site (e.g. still bottoms, other solvents). Off-site recovery may totally eliminate the need for direct off-site disposal of solvent wastes, as well as result in additional savings over current management methods.

Incorporation of all of these measures in conjunction with GE's current solvent recovery system can effectively eliminate off-site disposal of chlorinated solvent wastes.

3.2 MIXED FLAMMABLE SOLVENT WASTE

3.2.1 Waste Description and Management Practices

A mixed solvent waste stream is generated from hand-applied cleaning operations located throughout AFP 59. Non-chlorinated cleaning solvents including acetone, toluene and alcohols are distributed daily to bench work areas in small (generally 8 oz.) plastic bottles. During distribution of new solvent, dirty solvent and empty bottles are collected. Solvent waste is consolidated into 55 gallon drums for storage and eventual off-site shipment to Frontier Chemical. Wastes are blended by Frontier for fuel value.

Solvent waste consists of a mixture of acetone, toluene and alcohols contaminated with oils, flux and dirt. A detailed analysis is not available; however, GE estimates that the waste consists of approximately 95 percent solvent and 5 percent contaminants. The predominant solvent in the waste is acetone.

In 1984, GE generated and disposed only 2000 lb (290 gal) of mixed flammable solvent waste. At Frontier's unit cost of \$28/drum and \$23.70/drum transportation, the total 1984 cost for disposal was \$240.

3.2.2 Waste Minimization Opportunities

The mixed flammable solvent waste stream is suitable for recovery in an on-site distillative recovery system. However, a dedicated unit cannot be justified economically or operationally because of the low volume of waste generated. In addition, recovered cleaning solvents would probably not meet military specifications for hand cleaning operations. In light of these two impediments, the current waste management method employed by GE (i.e. off-site contracted fuel blending) appears to be the most environmentally sound off-site option.

On-site recovery of flammable solvent waste may be possible in the system recommended for recovery of paint clean-up solvent (see Section 3.3). In this arrangement, cleaning solvents could be mixed with paint solvent wastes, increasing the volume of recoverable wastes. The major question to be answered in this arrangement is whether cleaning solvents would be suitable for paint booth cleaning operations. In general, the solvents in the flammable solvent waste stream (particularly acetone and toluene) are suitable paint cleaning materials and would not be detrimental to spray gun or booth cleaning operations. A discussion of this combined recovery option is presented in Section 3.3.

3.2.3 Recommendations

GE should investigate the feasibility of reuse of recovered cleaning solvents from a paint waste recovery system for paint booth clean-up operations. If these wastes could be combined prior to recovery and find use in paint booth operations, additional savings could be realized over current disposal methods. Additionally, reliance on off-site contractors and the associated potential liabilities could be further reduced.

3.3 PAINT/LAQUER WASTE

3.3.1 Waste Description and Management Practices

A mixed paint, laquer and solvent waste stream is generated from GE's painting room (Area 810). Waste results from paint spray equipment, paint booth and general cleaning, and paint wastage. Waste from these operations is collected in 55-gallon drums, which, when full, are transported to GE's storage facility. Wastes are sent with other solvent wastes to Frontier Chemical for fuel blending.

The concentration of wastes from the paint booth vary significantly depending on the level of operation and cleaning. In general however, it is estimated that wastes are 50 percent solvent--a mixture of MEK, xylene and toluene--and 50 percent paint and laquer solids from primer and top coat materials.

In 1984, 8000 lb (800 gal) of paint/laquer wastes were collected in drums and disposed by Frontier Chemical. Based on unit costs of \$85/drum and \$12.70/drum transportation, total disposal costs were \$1,560 in 1984.

3.3.2 Waste Minimization Opportunities

Solvent wastes from the paint booth could be recycled on-site for reuse in paint booth clean-up operations through distillative recovery. Incorporation of a system similar to that currently used by GE for recovery of 1,1,1-trichloroethane from degreaser wastes, could reduce current paint/laquer waste disposal volumes and raw material clean-up solvent usage.

Several economical, compact distillative solvent recovery units are currently available for small volume users. A listing of several manufacturers and system specifications is provided in Table 3-5. These systems are small enclosed units that can be placed in the area of solvent generation for dedicated use. Such an arrangement is recommended to minimize the potential for recovered clean-up solvents being utilized in operations where military specifications require higher quality solvent. Typically, small recovery units consist of a distillation system combined with a cleaning station and dirty solvent storage tank, and clean solvent storage tank. In paint booth cleaning operations, spray guns are cleaned with solvent in the cleaning station which drains to the dirty solvent storage tank. When sufficient quantity is available for system operation, the unit is switched on; separation of solids and solvent and system shutdown occurs automatically. After operation, solvent from the unit's clean storage tank is reused for clean-up. Residues are contained in a disposable bag which can be removed and disposed as a hazardous waste.

As stated above, GE generates approximately 800 gal of paint/laquer waste with 50 percent solvent content. The smallest unit commercially available is approximately 14-15 gal/batch. Frequency of operation would be approximately weekly (i.e., 53-57 batches required annually). A recovery

TABLE 3-5
TYPICAL SOLVENT DISTILLATION SYSTEM SPECIFICATIONS

| MANUFACTURER | UNIT | MAX. SOLVENT BOILING POINT | CAPACITY | COST |
|--------------------|---------|----------------------------------|---------------|----------|
| Finish Engineering | LS-15 | 320°F | 15 gal/batch | \$ 5,030 |
| | LS-55 | 320°F | 55 gal/batch | 12,806 |
| Recyclene | RS-35 | 400°F | 35 gal/batch | 11,900 |
| | RS-70 | 400°F | 70 gal/batch | 20,200 |
| Venus | SRS-5 | 320°F | 56 gal/batch | 10,560 |
| | SRS-20 | 320°F | 100 gal/batch | 20,595 |
| Brighton | 7.5 GPH | 350°F | 60 gal/batch | 17,500 |

efficiency of 85 percent of solvent content is typically achievable for paint solvent mixtures. Based upon these estimates, approximately 340 gal of solvent can be recovered. Avoided new material purchase costs are projected to be \$2,270/yr (based on average unit costs of xylene, toluene and MEK), with accompanying disposal cost reductions of \$680/yr. Operation and maintenance costs for the unit are estimated to average \$0.20/gal or \$160/yr, resulting in a net savings of \$2,790/yr. Based on a capital cost estimate of \$6,000 for a 14-15 gal/batch unit, a two year payback may be achieved. A summary of the economics of this system is presented in Table 3-6.

An additional opportunity that should be considered is recovery of mixed flammable solvent waste (described in Section 3.2) in the proposed unit for reuse in paint booth clean-up operations. By inclusion of these wastes, the economics of solvent recovery are improved. A summary of the economics of a combined system is also presented in Table 3-6. As shown, additional savings of \$1,690/yr are possible reducing payback estimates to 1.3 years.

Finally, it should be noted that the economic projections provided in Table 3-6 may actually prove to be more favorable than shown. A properly operated solvent recovery unit has been shown to reduce vapor losses during waste collection because of the cleaning station arrangement. Solvents that are now lost from open collection containers could be retained in the unit and be recovered for reuse through distillation. No estimates are available for reductions of vapor losses achievable.

3.3.3 Recommendations

GE should acquire a dedicated, stand-alone solvent distillation workstation for recovery and reuse of clean-up solvents in their paint spray booth. The unit should be located in or near the spray booth to encourage its use and minimize the opportunity for cross-use of recovered solvent. System operation should be limited to non-chlorinated paint booth clean-up solvent and mixed flammable solvent if they are found to be suitable for paint booth cleaning. Training should be provided to paint booth operators to ensure proper use. A routine program should be instituted whereby solvent recovery is conducted on a periodic basis such as once per week; solvents are placed directly into the unit storage tank; routine maintenance is conducted; and solids are recovered regularly for disposal.

TABLE 3-6
SOLVENT WASTE MINIMIZATION OPTIONS

| ALTERNATIVE | WASTE REDUCTION (GALLONS/YR) | CAPITAL COST (\$) | AVOIDED COST (\$/YR) | O&M COSTS (\$/YR) | NET SAVINGS (\$/YR) | PAYBACK (YRS) |
|---|---------------------------------|-------------------------|----------------------------|-------------------------|---------------------------|------------------|
| 1. Recovery of solvent from paint/laquer waste | 340 (43%) | 6,000 | 2,950 ¹ | 160 ² | 2,790 | 2.2 |
| 2. Recovery of solvent from paint/ laquer and mixed flammable solvent waste | 580 (53%) | 6,000 | 4,700 ³ | 220 ³ | 4,480 | 1.3 |

1 Includes avoided disposal and raw materials costs. Disposal costs are assumed to be the same as current costs (i.e. \$97.70/drum). Raw material costs are based on straight average of xylene, toluene and MEK purchase costs (i.e. \$6.70/gal).

2 O&M cost estimates are based on historical vendor estimates (\$0.20/gal).

3 Includes avoided costs described in (a); avoided disposal costs for flammable wastes based on current costs of \$40.70/drum and sludge disposal of \$97.70/drum; and avoided paint solvent costs (i.e. \$6.70/gal).

3.4 COOLANT WASTE

3.4.1 Waste Description and Management Practices

Machining operations at AFP 59 require soluble oil/water emulsion coolants for lubrication and cooling of aluminum parts during metalworking. After prolonged use of the coolant, it is degraded as evidenced by ineffective lubrication, rancidity, and free floating tramp oils. When shop operators determine that coolants require replacement, coolant is pumped from machine sumps by a portable vacuum cart and transferred to a newly constructed bulk storage tank, where it is mixed with small quantities of other waste oils. Wastes are transported and treated by Speedy Oil Company of Niagara Falls, NY. Treatment involves oil-water separation by chemical and physical methods. Oils are blended for fuel value, and wastewater is discharged to a POTW.

GE uses a Trimsol water soluble cutting oil in machining operations. A typical make-up of the cutting oil is:

- o 60-90% mineral oil
- o 1-5% water
- o 5-30% emulsifiers
- o 1-20% coupling agents
- o 1-10% rust inhibitors
- o 0-10% bactericide (generally chlorophenols).

Cutting oil is mixed with water to a 20:1 to 50:1 (water:oil) ratio. Waste coolants pumped from machine sumps typically contain this cutting oil/water mixture with 3-5 percent tramp oil and high solids content.

GE estimates that 100,000 lb (12,000 gal) of waste coolant were transported to Speedy Oil for treatment in 1984. Costs for treatment were \$0.25/gal or \$3,000 in 1984. A material balance of the coolant system at GE is as follows:

- o Coolant make-up - 750 gal Trimsol, 14,250 gal water
- o Evaporative losses - 150 gal Trimsol, 2,850 gal water (25%)
- o Waste disposal - 600 gal Trimsol, 11,400 gal water

3.4.2 Waste Minimization Opportunities

Advances in coolant recovery technology have allowed industrial facilities to greatly extend the life of coolants and thereby reduce costs for new cutting fluid purchases and treatment or disposal costs for waste coolant. Several technologies are

commercially available to remove tramp oils and other impurities from coolants so they can be made-up with fresh cutting fluid and reused in machining operations. Two technologies that are most often applied for on-site coolant recovery are coalescing plate filters and centrifugation systems. Generally, centrifugation is more effective in separating tramp oils from coolant, but centrifugal units are significantly more expensive (generally 5 to 10 times the cost of plate filtration systems).

Using either system, GE can significantly decrease waste disposal from machining operations. System operation would involve transporting waste coolant, as it fails or on a regular cycle, to a recovery unit located in a central location (e.g., like the 1,1,1-trichloroethane recovery unit). Wastes are run through the recovery system resulting in separation of cleaned coolant from contaminants. Tramp oils and solids are collected separately for off-site disposal or sale for fuel blending. Recovered coolant is tested and mixed with new coolant and reused in machining operations. To extend the life of recovered coolant further, bactericides may be added to delay bacteria growth and rancidity.

The economics of coolant recovery are favorable. Currently, GE disposes of approximately 12,000 gal/yr of waste coolant at a cost of \$3,000 and uses 750 gal/yr of new Trimsol at a cost of \$12.00/gal or \$9,000/yr. Implementation of a coolant recovery unit can effectively reduce cutting fluid usage to 25 percent of normal use. This estimate is based on the assumption that 25 percent of coolant becomes tramp oil at the time of replacement. In GE's current operation, the entire batch is disposed. With recovery, the tramp oil is removed from the reusable coolant, which is made up with lost cutting fluid. More significantly, waste coolant disposal is reduced from current levels of 12,000 gal/yr to 150 gal/yr, the total amount of tramp oil removed from waste coolant.

Based on this analysis, disposal costs can be reduced to only \$40/yr and raw material costs reduced to \$2,250. This system can provide a payback of one year for plate filtration and five years for centrifugation recovery units.

A summary of economics for centrifugation and plate filtration systems is provided in Table 3-7.

TABLE 3-7
COOLANT WASTE MINIMIZATION OPTIONS

| ALTERNATIVE | WASTE REDUCTION (GALLONS/YR) | CAPITAL COST (\$) | AVOIDED COST (\$/YR) | O&M COSTS (\$/YR) | NET SAVINGS (\$/YR) | PAYBACK (YRS) |
|--|---------------------------------|-------------------------|----------------------------|-------------------------|---------------------------|------------------|
| 1. Recovery by centrifugation | 11,800 (98%) | 50,000 | 9,7101 | 6002 | 9,100 | 5 |
| 2. Recovery by coalescing plate filtration | 11,800 (98%) | 10,000 | 9,7101 | 6002 | 9,100 | 1.1 |

1) Includes avoided disposal and raw material costs. Disposal costs are based on current unit costs of \$0.25/gal. Avoided raw material costs are based on Trimsol costs of \$12.00 gallon and 75% reduction in Trimsol use.

2) Based on O&M unit costs of \$0.05/gal

3.4.3 Recommendations

On-site coolant recovery appears to be a viable alternative for AFP 59 machining operations. It is recommended that GE investigate alternative coolant recovery systems, including coalescing plate filtration and centrifugation units. Based upon economics and system recovery efficiency, GE should acquire a unit to reduce current waste disposal volumes. This recommendation is further supported by new regulations being considered by EPA to classify waste oils as a hazardous waste. Economics of coolant recovery can be expected to become more favorable with such a change.

In addition, it is recommended further that GE:

1. Use bactericide additives for recovered coolant to achieve greatest useful coolant life.
2. Recover coolant on a routine (e.g. monthly) schedule to minimize coolant degradation and sump cleaning requirements, thereby extending coolant life.
3. Use deionized water for coolant make-up to reduce mineral build-up and extend coolant life.

3.5 CYANIDE PLATING BATH WASTE

3.5.1 Waste Description and Management Practices

GE's metal finishing operations include cadmium cyanide and copper cyanide plating lines. Waste baths from these plating lines are pumped from plating tanks located in Area 926 to 55 gallon drums by Frontier Chemical. Waste cyanide baths are transported to Frontier's treatment facilities for treatment by cyanide destruction and chemical precipitation. Treated effluent is discharged to the Niagara POTW and dewatered sludges are landfilled.

Cyanide plating wastes have varying compositions, as baths are contaminated during plating operations and mixed together in various ratios. Typically, plating bath make-up chemicals present include the following:

- o Copper-cyanide line - Copper cyanide, sodium cyanide, sodium carbonate, sodium hydroxide and salts.
- o Cadmium cyanide line - Cadmium cyanide, cadmium oxide, sodium cyanide, sodium hydroxide, and sodium sulfide.

A typical waste stream from GE's cyanide plating lines is estimated to consist of approximately:

- o 1-3 percent cadmium
- o 1-3 percent copper
- o 5-10 percent cyanide
- o 8-15 percent sodium
- o 70-80 percent water
- o other salt, solids, and organic contaminants.

In 1984, GE shipped off-site 2000 lb (235 gal) of cyanide plating baths. Based on Frontier's treatment costs of \$65/drum and \$12.70/drum transportation, GE spent \$390 for treatment of cyanide wastes.

In addition to this cyanide plating bath waste, plating rinsewaters are generated and collected in GE's general rinsewater collection system. Rinsewater flow and concentration is not known, but it is estimated that both flows and concentrations are negligible with respect to total plating rinsewaters. Rinsewater waste management practices are discussed in Section 3.7.

3.5.2 Waste Minimization Opportunities

GE recognizes the potential hazards associated with cyanide operations and has been gradually cutting back on cyanide plating operations, resulting in decreased waste cyanide bath generation. Elimination of cyanide plating operations can reduce off-site treatment costs and can decrease the potential risk to operations personnel. Technologies are available to eliminate cyanides from GE's plating operations.

Cadmium plating has traditionally been conducted with alkaline cyanide baths, such as that used by GE, because of the higher plate quality provided. In the recent past, alternative plating systems have been developed involving cadmium fluoborate, sulfate or chloride compounds. Other replacement systems include ion vapor deposition and vacuum deposition, but these generally require significant capital expenditures and would not be suitable for small production volumes typical at GE.

The most promising of the alternatives available for cadmium cyanide replacement appears to be acid cyanide plating. One such plating solution is manufactured by LeaRonel, Inc. of Freeport, NY under the trade name "Kadizid" plating solution. This proprietary bath solution consists of cadmium oxide,

sulfuric acid, and brightener, starter, and stabilizer compounds. Lockheed-Georgia Company at AFP 6 incorporated this acid cadmium plating system in August, 1983. Lockheed has found no reduction in product quality following changeover, but has realized a slight reduction in operating costs and total elimination of cyanide operations. Based upon initial conversations with vendors and Lockheed, GE can experience a small reduction in the treatment cost of cadmium solution which will be offset by increased raw material costs.

3.5.3 Recommendations

GE is currently managing cyanide plating wastes in the most environmentally sound manner possible: cyanide destruction and metals precipitation by an off-site treatment facility. However, based upon analysis of cyanide plating bath replacement alternatives, changeover to a non-cyanide process may be possible for GE and should be investigated. It is recommended that GE evaluate acid cadmium plating to determine its effectiveness, implementability and economics for use at AFP 59.

3.6 ACID PLATING BATH WASTE

3.6.1 Waste Description and Management Practices

GE generates a mixed waste stream from metal finishing operations located in Area 926. This waste stream consists of a varying mixture of spent surface preparation, plating and cleaning baths which, through routine chemical analysis, are determined not to meet GE process control specifications. When a bath is spent, it is pumped by portable pump from the plating tank to a pipe system located in the rinsewater collection trench. Waste flows to the waste storage tank located outside of Area 926, where it is mixed with other spent baths and backwash wastes from GE's rinsewater ion exchange system (See Section 3.8). When sufficient quantity is available for transport, wastes are transferred in bulk to Waste Conversion, Inc. of Hatfield, PA for treatment. Treatment consists of neutralization, chrome reduction, chemical precipitation and sludge dewatering. Clarified water is discharged to a POTW and sludges are landfilled.

The content of waste generated from plating operations varies as different baths are collected in the common storage tank. However, as the predominant waste generating line at AFP 59 is

chrome plating, this waste is stated by GE to be typically acidic with significant chromium and other metal ion contaminants. No cyanide baths are collected with these wastes. A typical analysis of the acid plating bath waste stream is shown in Table 3-8.

In 1984, 338,000 lb (39,800 gal) of acid plating bath waste were treated by Waste Conversion, Inc. Based on unit costs of \$0.034/lb and \$900/truckload for transportation, total treatment costs for 1984 were \$18,700. It should be noted that GE incorporated an ion exchange system for recovery of plating rinsewaters at the end of 1984. Backwash and regeneration wastes from this system are now being collected with the acid plating bath for treatment. A discussion of this additional waste volume is provided in Section 3.8.

3.6.2 Waste Minimization Opportunities

Alternatives to GE's current practice of off-site treatment of acid plating baths include:

1. Segregation and off-site recovery of plating solutions.
2. On-site treatment of spent plating baths.

Each of these alternatives is discussed below.

3.6.2.1 Off-Site Recovery of Plating Solutions

Several off-site recovery operations have been established in the recent past providing a frequently cost-effective alternative to treatment of spent plating solutions. Typically, recovered materials have a value that exceeds the cost of recovery. Thus, recovery facilities often offer a small net revenue for wastes. The actual cost or revenue resulting from waste recovery depends primarily on level of contamination, plating bath concentration and transportation distances. No estimate of reduction in current acid plating bath waste disposal volumes can be made without testing by off-site recoverers. However, in many cases, through off-site recovery, wastes can be eliminated from off-site treatment resulting in a parallel reduction in sludge disposal associated with which results from metal precipitation during treatment.

TABLE 3-8
TYPICAL ACID PLATING BATH
WASTE ANALYSIS*

| PARAMETER | ANALYSIS |
|------------------------|------------|
| Total Residue | 25.5% |
| Total Dissolved Solids | 14.1% |
| Total Volatile Solids | 11.7% |
| pH | 5.1 |
| Cyanides | 4.5mg/l |
| Oil & Grease | <0.01 mg/l |
| Ammonia as N | 1137 mg/l |
| Phenol | 68.5 mg/l |
| Arsenic | 2.16 mg/l |
| Antimony | N/A |
| Barium | 3.23 mg/l |
| Cadmium | 0.13 mg/l |
| Chromium | 4419 mg/l |
| Lead | 6.35 mg/l |
| Mercury | 1.55 mg/l |
| Nickel | 20.65 mg/l |
| Selenium | 0.82 mg/l |
| Silver | 2.58 mg/l |
| Copper | 144.5 mg/l |
| Molybdenum | 1.29 mg/l |
| Zinc | 9.29 mg/l |
| COD | 300 mg/l |

*Taken from 2-25-82 waste chemical analysis performed by Waste Conversion, Inc.

3.6.2.2 On-Site Treatment

An alternative to off-site treatment of acid plating baths is on-site treatment. On-site treatment provides greater control over the treatment process, reducing the potential for liability resulting from off-site treatment operations. It does not, however, reduce any liabilities associated with off-site disposal of wastewater treatment sludges, as sludges would be generated in any treatment alternative.

A comparison of the economics of on-site and off-site treatment of acid plating baths is presented in Table 3-9. As shown, capital costs for an on-site treatment system are estimated to be \$8,750. Annual operating costs are estimated to be \$28,000/yr compared with total off-site costs of \$19,100/yr. This comparison shows off-site treatment to be the most cost-effective option for management of acid plating baths.

GE's current practice of contracted off-site treatment of acid plating bath wastes appears to be the most cost-effective management alternative. This conclusion is based on the following:

1. Significantly lower cost of off-site treatment over on-site treatment.
2. Insignificant reduction in liabilities through on-site treatment in light of sludge disposal requirements of both the on-site and off-site treatment alternatives.
3. Potential inability to meet Johnson City pretreatment requirements through on-site treatment.
4. O&M difficulties associated with operation of a concentrated waste treatment system.

3.6.3 Recommendations

In light of the increased costs associated with on-site treatment of acid plating wastes and the relatively insignificant change in liabilities associated with on-site treatment, it is recommended that GE continue their current waste management practices. However, it is also recommended that GE investigate the potential for sale of specific plating bath solutions to off-site recovery firms. Recovery can decrease current costs for waste treatment, reduce landfill requirements through reduced sludge generation, and enhance GE's active waste minimization program.

TABLE 3-9
ECONOMICS OF ON-SITE AND OFF-SITE
ACID PLATING BATH TREATMENT

| ITEM | ON-SITE TREATMENT COST* | OFF-SITE TREATMENT COST* |
|-----------------------|-------------------------------|--------------------------------|
| 1. Capital Cost | | |
| o Equipment | 5,000 | 0 |
| o Installation (50%) | 2,500 | 0 |
| o Engineering (10%) | 500 | 0 |
| o Contingencies (15%) | 750 | 0 |
| <u>TOTAL</u> | <u>\$8,750</u> | <u>0</u> |
| 2. Annual Cost | | |
| o Personnel | \$8,000/yr. | \$ 400/yr. |
| o Chemicals | 2,400/yr. | 0 |
| o Utilities | 200/yr. | 0 |
| o Analysis | 4,000/yr. | 0 |
| o Disposal | 13,400/yr. | \$18,700/yr. |
| <u>TOTAL</u> | <u>\$28,000/yr.</u> | <u>\$19,100/yr.</u> |

*Calculations are provided in Appendix B.

3.7 PLATING RINSEWATER

3.7.1 Waste Description and Management Practices

Plating operations conducted in Area 926 generate waste rinsewaters that are currently recycled by GE. In the past, GE treated plating rinsewaters by ferrous sulfate chromium reduction and gravity settling. Treated effluent overflowed to a settling tank to outfall #01 for discharge to Choconut Creek. A major concern with the treatment system was that manual addition of ferrous sulfate was resulting in occasional hexavalent chromium discharges exceeding SPDES permit limitations. This prompted GE to study alternative treatment options for plating rinsewaters. As a result of a study conducted by O'Brien & Gere in October, 1983, treatment of rinsewaters by ion exchange and recycle of deionized water for rinsing was incorporated at AFP 59.

The rinsewater recovery system operates on demand. Rinsewaters overflow plating rinse tanks to a trench system which flows to a collection tank located adjacent to the acid plating waste storage tank. As rinsewater level increases to a set level, it is pumped to the ion exchange system consisting of anion and cation exchange columns. Deionized water is stored in a 5000 gallon underground tank from which it is pumped for reuse in plating rinse tanks. Backwash and regeneration wastes are collected with acid plating bath wastes for off-site treatment as described in Section 3.8.

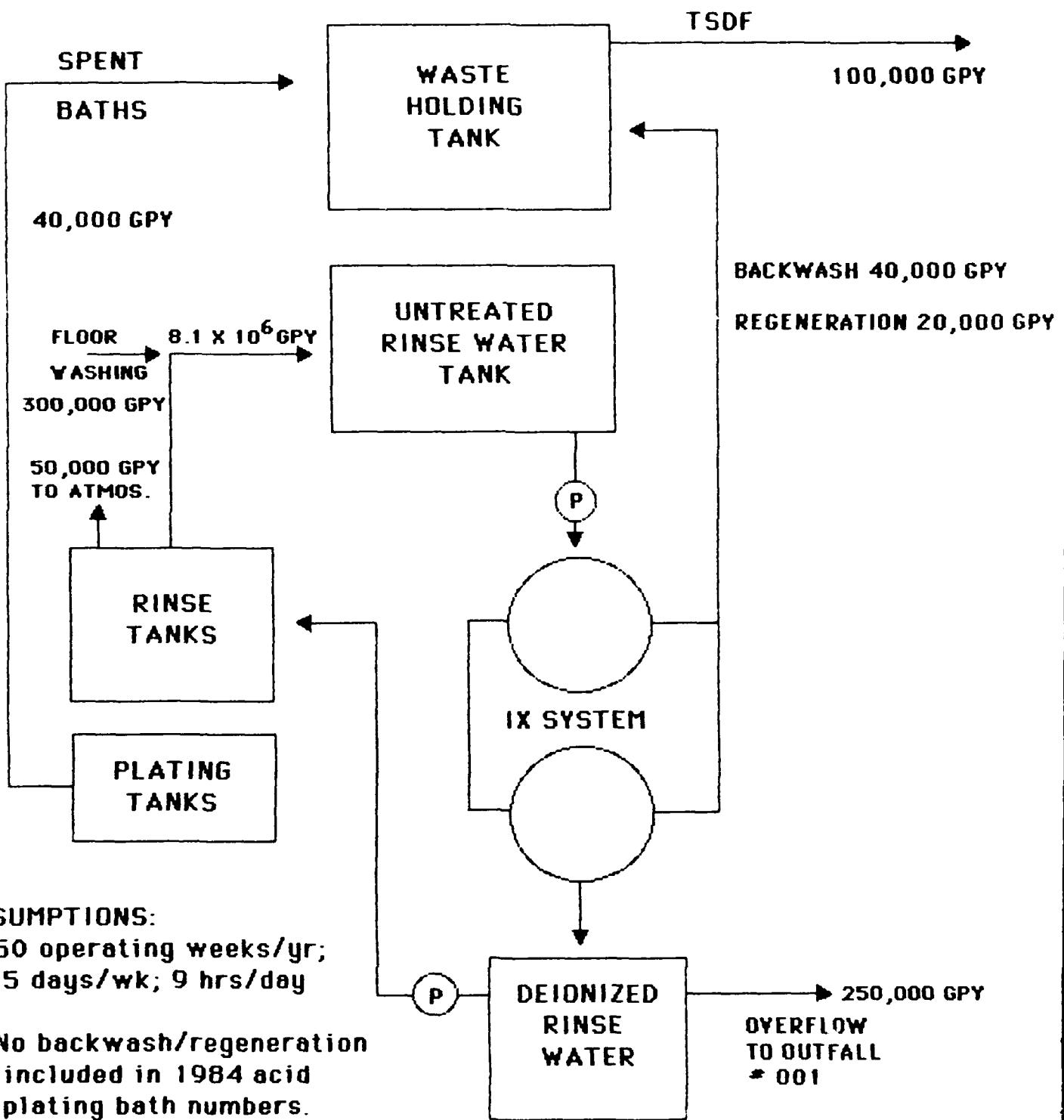
Rinsewater collected for treatment in the ion exchange system is generated primarily from chrome plating rinse tanks with other sources including alkaline and acid cleaning rinses, other metal plating rinses and floor washings. A typical analysis of the influent to the ion exchange system is provided in Table 3-10.

Plating rinsewater generation was estimated to be 67.6 million lb (8.1 million gal) in 1984. A water balance of the current system is provided in Figure 3-2. As shown, current rinsewater discharge rates are 250,000 gal/yr, resulting from overflow of the deionized rinsewater tank. This overflow is caused by input of water from floor washing operations which exceed plating rinsewater requirements. Based on this water balance, GE has reduced its discharge of plating rinsewaters from 8.1×10^6 gal/yr to 250,000 gal/yr (97 percent reduction). This system has also resulted in concentrated wastes from backwashing and regeneration which require off-site treatment. These wastes are discussed in Section 3.8.

TABLE 3-10
TYPICAL RINSEWATER ANALYSIS

| <u>PARAMETER</u> | <u>CONCENTRATION</u> (mg/l) | <u>PARAMETER</u> | <u>CONCENTRATION</u> (mg/l) |
|------------------|--------------------------------|---------------------|--------------------------------|
| Cations | | Heavy metals | |
| Calcium | 86 | Chromium | 0.23 |
| Magnesium | 14 | Lead | < 0.01 |
| Sodium | 24 | Copper | 0.05 |
| Potassium | 1.9 | Nickel | 0.03 |
| Ammonia | 0.61 | Tin | < 0.05 |
| Iron | 12 | Silver | < 0.01 |
| Aluminum | 1.3 | | |
| Anions | | | |
| Chloride | 38 | | |
| Sulfate | 79 | | |
| Fluoride | 1.1 | | |
| Nitrate | 3.0 | | |
| Silicate | 3 | | |
| Phosphate | 0.02 | | |
| Bicarbonate | < 0.5 | | |
| Other | | | |
| pH | 7.2 | | |
| TDS | 370 | | |
| TOC | 3 | | |
| Total Alkalinity | 152 | | |
| TSS | 40 | | |

FIGURE 3-2
ANNUAL
PLATING WASTE GENERATION
BALANCE



3.7.2 Waste Minimization Opportunities

GE has reduced its discharge of wastewaters resulting from plating rinse operations by 97 percent through installation of an ion exchange recovery system. This system has also enabled a parallel reduction in rinsewater consumption. Through incorporation of this system, GE has decreased the cost of treatment and discharge of rinsewaters from \$28,700, based on \$0.67/1000 gal sewer charges and \$2.92/1000 gal treatment costs for the ferrous sulfate treatment system, to \$12,000, based on \$0.67/1000 gal sewer charges and \$1.48/1000 gal for the ion exchange system operations cost. In addition, a reduction in water costs of \$5,300 was achieved, based on water costs of \$0.66/1000 gal. A comparison of system economics is presented in Table 3-11.

The increased cost associated with the ion exchange system is caused by high levels of backwashing and regeneration required to date. A detailed discussion of these wastes is provided in Section 3.8. Improvements of current system operations could reduce this volume of waste generation resulting in more favorable system economics.

In addition to the ion exchange system implemented by GE, additional opportunities are available to reduce rinsewater volumes. As reported by O'Brien & Gere, several flow reduction techniques were tried by GE, including automatic flow control by continuous conductivity measurement. GE found that maintenance requirements, typical for continuous monitoring devices, quickly caused removal of these systems. Other measures incorporated by GE and still used on some tanks to reduce flow rates include in-line flow restrictors and air agitation feed lines.

Additional measures which deserve investigation include countercurrent, reactive and spray rinsing. Each of these measures has shown significant reductions in water usage as well as reduced costs associated with waste treatment. For example, countercurrent series rinsing with 3 tanks has been documented throughout the plating industry to reduce water consumption by 99 percent over one-tank rinsing operations. Through incorporation of simple flow modifications, GE could experience both reduced water costs and reduced ion exchange system operating costs and may be able to reduce or eliminate discharge of excess water to outfall #1.

An assessment of alternative rinsing schemes involves a detailed investigation of plating line arrangement, space availability and capital costs for new equipment, which cannot be conducted with available data. However, an investigation of rinsewater reduction methods appears warranted at AFP 59.

TABLE 3-11
ECONOMICS OF GE'S PAST TREATMENT
AND CURRENT ION EXCHANGE SYSTEM

| ITEM | FERROUS SULFATE TREATMENT (\$/YR) | ION EXCHANGE (\$/YR) |
|---------------------------------|---|----------------------------|
| Discharge of Wastewater | 5400 ¹ | \$ 170 |
| Make-up Water | 5400 ² | 0 |
| Treatment System Operation | 23700 ³ | 11,800 ⁴ |
| Concentrated Waste Treatment | 0 ⁵ | 28,000 ⁶ |
| TOTAL | \$34,500 | \$40,000 |

- 1) Based on \$0.67/1000 gal
- 2) Based on \$0.66/1000 gal
- 3) Based on \$2.92/1000 gal estimated treatment costs
- 4) Based on \$1.48/1000 gal estimated treatment costs
- 5) Included in treatment operation
- 6) Based on current backwash/regeneration rates and Waste Conversion, Inc. treatment costs

3.7.3 Recommendations

It is recommended that GE investigate rinsewater flow reduction measures to supplement the substantial savings already realized through ion exchange recovery. These measures should include at a minimum:

1. Consolidation of rinse tanks (i.e. use rinse tanks for more than one plating line).
2. Countercurrent rinsing in a series of tanks.
3. Reactive rinsing.

In addition to these larger flow modification alternatives, GE should incorporate simple flow control measures on all rinse tanks, as necessary. Each rinse tank should include an in-line flow restrictor to provide a reduced flow rate that does not impact product quality. Each rinse tank should also be equipped with air agitation to promote effective rinsing. Mechanical flow restrictors cost approximately \$10/tank and air agitation costs approximately \$60/tank. Both of these devices are inexpensive means to control flow rates that do not rely on sophisticated monitoring or control.

3.8 ION EXCHANGE SYSTEM WASTE

3.8.1 Waste Description and Management Practices

Backwash and regeneration wastes are collected with acid plating bath wastes for treatment by Waste Conversion, Inc.. This waste stream is discussed separately because it was not included in 1984 waste generation figures and is a new waste stream with little generation history (and likely to change). Operation of the ion exchange system, to date, has shown that backwashing is required approximately twice per week and uses 400 gal per backwash. Regeneration is required slightly more frequently than once per month and requires approximately 1600 gal per cycle. Based upon these estimates, annual projections of waste generation are 40,000 gal/yr of backwash water and 20,000 gal/yr of regeneration wastes. Therefore, a total of 60,000 gal/yr will be added to the 39,800 gal of acid plating bath treated by Waste Conversion, Inc. in 1984. As shown in Table 3-10, this additional treatment requirement will cost \$28,100, based on current treatment costs, causing overall operation costs to be higher than past treatment by ferrous sulfate. Although this comparison is not completely relevant as a new treatment system was required to meet discharge limitations, the increase of wastes requiring off-site management warrants investigation. It should be noted that GE expects these rates experienced to date to decrease with operational experience.

3.8.2 Waste Minimization Opportunities

Current levels of backwashing and regeneration appear to be much higher than originally projected by O'Brien & Gere. In their October, 1983 report, regeneration estimates were twice per year with a total of 825 gal (300 gal of 4 percent NaOH and 525 gal of 66°Be H₂SO₄) based on resin manufacturer's estimated regenerant loadings. Table 3-12 presents design parameters for GE's ion exchange system. For comparison, calculations made during this investigation estimate the following regeneration requirements:

- o Anion Exchange - regeneration with 2100 gal 4% NaOH and rinsing with 5300 gal H₂O, 3 cycles per year
- o Cation Exchange - regeneration with 1500 gal 66°Be H₂SO₄ and rinsing with 44,000 gal H₂O, 125 cycles per year

In total 55,000 gal/yr of waste is estimated for regeneration and rinsing. This value is close to GE's operational experience of 60,000 gal/yr. It appears that calculations made during initial study of waste treatment alternatives underestimated the quantity of waste generated from ion exchange regeneration.

Although current levels of regeneration/backwash waste generation experienced by GE compares closely with estimates, reductions may still be possible. Review of GE operations show the following major findings:

1. Significant volumes of floor washing wastes are generated at the facility, resulting in high loadings of cation and anion contaminants (and possible oils and greases) to the ion exchange system.
2. The largest component of waste generated from regeneration of ion exchange resins is slightly contaminated rinsewaters from backwash operations (approximately 40,000 gallons estimated by GE).
3. Regeneration of cation resins is required 40 times more frequently than anion resins. GE regenerates both columns on a regular basis, resulting in more regeneration wastes than necessary.

In light of these findings it appears that opportunities are available for reducing current levels of waste generation. Perhaps the largest of these alternatives is segregation of resin rinsewaters from regeneration wastes. Due to their very low level of contamination, rinsewaters can be reused in plating room operations. Potential reuse includes:

TABLE 3-12
AFP 59 RINSEWATER
ION EXCHANGE SYSTEM
DESIGN PARAMETERS*

DESIGN LOADINGS

Flow: 38,000 GPD (avg.), 53,000 GPD (peak)
Cr(VI): 1 mg/l, 0.32 lb/day (avg.)

DESIGN PARAMETERS

Hydraulic Loading: 2.0 GPM/cu. ft. resin (max.)

Anion Exchange:

Resin: Weak base, macroporous, free base form

Capacity: 2 lb Cr(VI)/cu. ft. resin

Regenerant: 4% NaOH, 3 lb NaOH/cu. ft. resin

Cation Exchange:

Resin: Strong acid, macroporous, hydrogen form

Capacity: 2 equivalents/liter resin

Regenerant: 4% HCl, 5 lb HCl/cu. ft. resin

*Taken from O'Brien & Gere Report "Wastewater Facilities Assessment" October, 1983

1. Make-up water for regeneration chemicals.
2. Make-up water for plating lines as plating bath or rinse water make-up.
3. Floor washing water.

In addition, it may be possible for ion exchange column rinsewaters to be remixed with untreated rinsewaters for treatment in the ion exchange system. The low concentrations of regeneration chemicals and other contaminants expected in these rinsewaters would not significantly impact ion exchange capacities of the current system.

Assuming that rinsewater reuse is possible in GE's plating room, 40,000 gal of waste can be eliminated from current off-site treatment volumes. This option represents a 67 percent reduction in waste volumes experienced from ion exchange system operation. At current costs of treatment (i.e. \$0.034/lb and \$900/truckload), savings of \$18,500 are possible. Payback of less than one year is possible. A summary of economics of the rinsewater recycle system is provided in Table 3-13.

In addition to these savings, reductions are possible for regeneration chemicals. GE currently regenerates both the cation and anion exchange columns on a monthly basis, even though anion regeneration may not be necessary more than 2 or 3 times per year, based on capacity calculations. Reduction of anion column regeneration from current rates of 13 times per year to 3 times per year will reduce regeneration of NaOH regenerant wastes from current rates of approximately 9000 gal/yr to only 2100 gal/yr. This reduction represents disposal savings of \$3,200 and chemical savings of \$200. These savings of \$3,400 are possible with no capital investment requirements, and immediate payback.

3.8.3 Recommendations

Based upon an analysis of GE's ion exchange system operation to date and calculations for ion exchange capacity and regeneration requirements, opportunities for minimizing waste generation are possible. The following recommendations are provided to reduce levels of waste requiring off-site treatment:

1. Segregate ion exchange system regeneration rinsewater from more concentrated regeneration wastes for reuse in plating room operations. GE should investigate the collection of rinsewater with plating rinsewaters for treatment in the ion exchange system. Additional uses of rinsewaters include:

TABLE 3-13
ECONOMIC ANALYSIS OF ION EXCHANGE SYSTEM WASTE REDUCTION OPTIONS

| ALTERNATIVE | WASTE REDUCTION (GAL/YR) | CAPITAL COST (\$) | AVOIDED COST (\$/YR) | O&M COST (\$/YR) | NET SAVINGS (\$/YR) | PAYBACK PERIOD (YRS) |
|---|-----------------------------|-------------------------|----------------------------|------------------------|---------------------------|----------------------------|
| 1. Collection of ion exchange rinses with plating rinsewaters | 40,000 | 500 | 18,500 ¹ | .03 | 18,500 | < 1 yr. |
| 2. Segregation of rinses for reuse in other plating room operations | 40,000 | 2,000 | 18,500 ² | .03 | 16,500 | < 1 yr. |
| 3. Reduce anion resin regeneration | 7,000 | 0 | 3,400 ² | .03 | 3,400 | Immediate |

1 Based on avoided disposal costs of \$0.034/lb and \$900/truckload.

2 Based on avoided disposal costs of \$0.034/lb and \$900/truckload and avoided regenerant costs of \$0.03/gal

3 Assumes no increase of O&M over current operation requirements

1. Regeneration chemical make-up.
 2. Plating and rinse tank make-up water.
 3. Floor washing operations.
2. Decrease the frequency of regeneration of anion exchange resins to that required; i.e., reduction from 13 times per year to calculated rate of 2-3 times per year.
 3. Investigate the potential reduction of floor washing to decrease loadings to the ion exchange system and reduce volume of rinsewater overflow from system.

APPENDIX A
UNIT WASTE MANAGEMENT COSTS

1. Frontier Chemical Waste Process, Inc.
Niagara Falls, NY
 - A. Fuel Blending (Drummed Wastes)
 1. Halogenated Solvents - \$78/drum
 2. Non-halogenated Solvents - \$26/drum
 3. Paint Residues & Laquer Thinners - \$85/drum
 - B. Cyanide Treatment - \$65/drum
 - C. Transportation - \$770/truckload of 80 drums or less
- \$508/truckload of 40 drums or less
Assume average cost of \$12.70/drum
2. Speedy Oil
Niagara Falls, NY
 - A. Oil-Water Separation/Disposal - \$.25/gal includes transportation
3. Waste Conversion, Inc.
Hatfield, PA
 - A. Acid Waste Treatment - \$.034/lb.
 - B. Transportation - \$900/truckload

APPENDIX B
DATA WORKSHEETS



The Earth Technology
Corporation

PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: 1. MIXED CHLORINATED SOLVENT WASTES

CHARACTERISTICS: MIXTURE OF 1,1,1 TRICHLOROETHANE,
FREONS, TCE WITH OIL & SOLID CONTAMINATION

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED IN DRUNS FROM 3 MAJOR SOURCES:
DEGREASERS, RECOVERY STILL BOTTOMS AND HAND CLEANING
OPERATIONS
STORED AND TRANSPORTED IN DRUNS

WASTE SENT TO FRONTIER CHEMICAL WASTE PROC INC.
FOR FUEL BLENDING (SOME TO CANADA FOR CEMENT KILN
INCINERATION)

GENERATION 1. RATE: 21 TPY (3500 GPY @ 12#/gal)
 2. FREQUENCY: CONTINUOUS
 3. COST: \$6400 (@ \$78/Drum + \$12.70/Drum-Trans)

PROPOSED CHANGES: 1. ELIMINATION OF TCE USAGE BY 9/85
2. REQUESTED FUNDING FOR FREON RECOVERY STILL IN FY87
COST ESTIMATE OF \$40K.

RAW MATERIAL DATA 1. CHARACTERISTICS: SEE ATTACHED
 2. QUANTITY: _____
 3. COST: _____

NOTES: 1. GE IS CURRENTLY RECYCLING 1,1,1 TRI DEGREASING SOLVENT
WITH A LEVAPUR STILL (INSTALLED 1978 FOR \$3500). REQUIRES
1 DRUM/BIN SHIFT. EACH BATH UNDERGOES RECOVERY 3 TIMES
BECFORE TOTAL BATH DISPOSAL. DISPOSAL REQUIRED BECAUSE OF
SPGR & VISUAL CLARITY, TEST FAILURE.

AFP 59 - GE
CHLORINATED SOLVENT USAGE

| SOLVENT | AVG. ANNUAL USE (GAL) | COST (\$/GAL) |
|--------------------|-----------------------|---------------|
| Trichloroethylene* | 500 | |
| Chlorethane VG | 7,000 | 5.10 |
| Freon TMS | 55 | 11.95 |
| Freon TE | 385 | 11.95 |
| Freon TF | 1,650 | 11.95 |

*Discontinuing use in 9/85, increased use of chlorethane use expected to offset decrease TCE usage.



PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: 2. MIXED FLAMMABLE SOLVENT WASTES

CHARACTERISTICS: MIXED SOLVENTS : ACETONE, TOLUENE,
& ALCOHOLS WHICH CONTAMINANTS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED IN DRUMS FROM HAND CLEANING
OPERATIONS LOCATED THROUGHOUT PLANT

STORED & TRANSPORTED IN DRUMS

WASTE SENT TO FRONTIER FOR FUEL BLENDING

GENERATION 1. RATE: 1 TPY (286 GPY @ 7#/gal)
 2. FREQUENCY: CONTINUOUS
 3. COST: \$240 (@ \$28/DRUM + \$2.70/DRUM TRAUS)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA 1. CHARACTERISTICS: SEE ATTACHED
 2. QUANTITY: _____
 3. COST: _____

NOTES: 1. MOST HAND-CLEANING SOLVENTS LOST TO ATMOSPHERE
DURING USE.

AFP 59 - GE
NON-CHLORINATED CLEAN-UP
SOLVENT USE

| SOLVENT | AVG. ANNUAL USE (GAL) | COST (\$/GAL) |
|----------------|------------------------------|----------------------|
| Acetone | | 1.75 |
| Toluene | 280 | 2.49 |
| Xylene | 85 | 14.20 |
| MEK | | 3.33 |



PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: S. PAINT/LAQUER WASTE

CHARACTERISTICS: THINNER SOLVENTS (MEK, XYLENE, TOLUENE)
WITH PAINT SLUDGES & RESIDUE

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: COLLECTED IN DRUMS FROM PAINT BOOTH
AREA AS A RESULT OF SPRAY GUN CLEANING, GENERAL CLEANING,
AND PAINT WASTAGE

DRUM STORAGE & TRANSPORT

WASTE SENT TO FRONTIER FOR FUEL BLENDING

GENERATION

1. RATE: 4TPY (800 GPY @ 10#/GAL)
2. FREQUENCY: CONTINUOUS
3. COST: \$1560 (@ \$85/drum + \$2.70/drum trans)

PROPOSED CHANGES: NONE

RAW MATERIAL DATA

1. CHARACTERISTICS: PRIMER COAT, ENAMEL TOP COAT, LAQUER
2. QUANTITY: UNKNOWN
3. COST: UNKNOWN

NOTES: PAINTING CONDUCTED PRIMARILY IN CENTRAL PAINT BOOTH AREA



PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: 4. WASTE COOLANT

CHARACTERISTICS: TRIMSOL COOLANT OIL MIXED
TO 2% - 5% WITH WATER. WASTE HAS SOLIDS AND
METAL CONTAMINANTS

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: ROUTINELY PUMP OUT METALLURGING MACHINERY
AND TRANSPORTED TO BULK STORAGE TANK

WASTE TRANSPORTED TO SPEEDY OILS, NIAGARA FALLS, NY
FOR OIL-WATER SEPARATION: OIL TO FUEL BLENDING,
WATER TO POTW

GENERATION 1. RATE: 100,000 #/Y (12000 GPY @ 8.34#/GAL)
 2. FREQUENCY: CONTINUOUSLY
 3. COST: \$3000 (@ \$0.25/GAL INCL TRANS.)

PROPOSED CHANGES: NONE LOOKED AT COOLANT RECOVERY BUT FOUND
IT TO BE UNECONOMICAL

RAW MATERIAL DATA 1. CHARACTERISTICS: TRIMSOL
 2. QUANTITY: 750 GPY (DISPOSAL + 25% LOSSES)
 3. COST: \$12.00 /GAL (\$9000/YR)

NOTES: EXPECTS GRADUAL REDUCTION OF MACHINING OPERATIONS
AND REDUCTION IN WASTE COOLANT GENERATION.



PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: 5. CYANIDE PLATING BATHS

CHARACTERISTICS: SPENT PLATING BATHS FROM CHROMIUM AND COPPER CYANIDE PLATING. CONTENTS INCLUDE Cd, Cu, H₂O, NaOH, Na₂CO₃, CN⁻ (NaCN KCN)
(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: PUMPED FROM PLATING BATHS IN BLDG #926
TO DRUMS

DRUM STORAGE AND TRANSPORT

TREATED BY FRONTIER USING CN DESTRUCT CHEMICAL PRECIPITATION. EFFLUENT DISCHARGED TO NIAGARA POTW

GENERATION

1. RATE: 1 TPY (235 GPY @ 8.5 #/GAL)
2. FREQUENCY: Periodic
3. COST: \$390 (@ \$65/Drum + \$12.70/Drum Trans)

PROPOSED CHANGES: GRADUAL ELIMINATION OF CYANIDE PLATING PROCESSES

RAW MATERIAL DATA

1. CHARACTERISTICS: VENDOR SPECS
2. QUANTITY: _____
3. COST: _____

NOTES:

TITLE: GE CYANIDE PLATING
WASTE COMPOSITION

PROJECT NO.: 85-005
PROJECT NAME: WMP-AFP59

PAGE 1
OF 1

ESTIMATE OF WASTE CYANIDE BATH CONCENTRATION

1. ASSUME TYPICAL

CADMIUM BATH MAKE UP:

250 lbs CdO
1260 lbs NaCN
500 lbs Na₂CO₃
200 lbs NaOH
H₂O

TO MAKE UP 1000 GAL
BATCH

2. ASSUME BATH DENSITY = 8.5 lb/gal

BATH WT. = 8500 lb.

3. CONCENTRATIONS : = WT/TOTAL WT.

CdO = 2.9%

NaCN = 14.8%

Na₂CO₃ = 5.9%

NaOH = 2.4%

H₂O = 74.0%

4. PRINCIPLE ION CONCENTRATIONS

Cd⁺ = 2.5%

CN⁻ = 7.9%

Na = 10.5%

5. ASSUME SIMILAR MAKE UP FOR COPPER BATH AND EQUAL MIX OF COPPER & CADMIUM WASTE

CONCENTRATION : Cd⁺ = 1-3% H₂O = 70-80%

Cu⁺ = 1-3%

CN⁻ = 5-10%

Na = 8-15%

BY:
DATE:

CHECKED BY:
DATE:

The Earth Technology
Corporation



PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: 6. ACID PLATING BATHS

CHARACTERISTICS: MIXTURE OF VARIOUS PLATING BATHS AND SURFACE PREPARATION SOLNS. SEE ANALYSIS ATTACHED

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: PUMPED FROM PAILS TO TRENCH PIPING SYSTEM WHICH FLOWS TO STORAGE TANK (WASTE IS NOW MIXED WITH IX REGENERATION & BACKWASH WASTE)

BULK TRANSPORT

TREATMENT BY WASTE CONVERSION INC. BY CHEM PRECIPITATION: WATER TO DWST, DENATURED SLUDGE TO CHEM LANDFILL

GENERATION

1. RATE: 169 TPY (39,800 GPY @ 85#/gal)
2. FREQUENCY: PERIODIC
3. COST: \$18,700 (@ \$0.034/# + \$900/TRUCKLOAD TRANS)

PROPOSED CHANGES: RATE WILL INCREASE DUE TO ADDITION OF REGENERATION & BACKWASH WASTES

RAW MATERIAL DATA

1. CHARACTERISTICS: UNKNOWN
2. QUANTITY: _____
3. COST: _____

NOTES:

1. WASTE VOLUME EXCLUDES IX REGENERATION & BACKWASH
(SEE ATTACHED FOR ESTIMATES)
ADDITIONAL 60000 GPY WASTE ESTIMATED

Waste Conversion

INC.

2869 Sandstone Drive / Hatfield, Pennsylvania 19440 / 215-822-8996

January 18, 1985

General Electric Company
Post Office Box 5000
Binghamton, NY 13902

ATTENTION: Mr. Pat Gilligan

SUBJECT: "Spent Plating Solution"
Lab Analysis No. 0798

Dear Mr. Gilligan:

As per our telephone conversation, enclosed please find a summary
of the lab results of the loads received by Waste Conversion, Inc.
in 1984.

| PICKUP DATE | SP. GR. | pH | REACTIVITY | ODOR | COLOR | GALLONS | ACID | CHROME | FLASH POINT |
|-------------|---------|------|------------|-----------------|-------|---------|------|--------|-------------|
| 12/10/84 | 1.10 | 7.5 | None | None | G/Y | 4,400 | N/A | 4,900 | > 140 |
| 11/1/84 | 1.06 | 13.0 | None | NH ₃ | G | 5,000 | N/A | 150 | > 140 |
| 10/5/84 | 1.10 | 7.8 | None | None | G | 5,000 | N/A | 451 | > 140 |
| 8/27/84 | 1.055 | 7.8 | None | Oily | G | 5,000 | N/A | 78 | > 140 |
| 7/25/84 | 1.005 | 1.6 | None | None | Y | 4,700 | 1.76 | 2,400 | > 140 |
| 7/16/84 | 1.05 | 8.4 | None | Solvent | Y/G | 4,500 | N/A | 4,120 | > 140 |
| 6/20/84 | 1.1 | 9.0 | None | None | G | 4,700 | N/A | 25 | > 140 |
| 4/11/84 | 1.1 | 6.2 | None | S. Sweet | G | 4,500 | 0.36 | 750 | > 140 |
| 2/17/84 | 1.1 | 10.0 | None | Sour | Y/G | 4,400 | N/A | 2,325 | > 140 |

Note: Color - G = Green, Y = Yellow

Acid - %

Chrome - mg/L

Flash Point - °F

As you can see there were several loads that should have been surcharged,
but were not.

Should you have any questions or if we can be of further assistance
to you, please feel free to contact this office.

Very truly yours,

WASTE CONVERSION, INC.

Debra S. Ditzler

Debra S. Ditzler
Office Manager

/dsd

WASTE CONVERSJON

INC.

2869 Sandstone Drive / Hatfield, Pennsylvania 19440 / 215-822-8996

Waste Generator: General Electric, Binghamton, New York

Waste Identification: Spent Plating Solution

Lab Code: 0798

| Test Parameter | Total Analysis | E/P Leachate |
|------------------------|---|---------------------|
| Total Residue | 25.5% | |
| Total Dissolved Solids | 14.1% | |
| Total Volatile Solids | 11.7% | |
| pH | 5.1 | Not Applicable |
| Cyanides | 4.5 mg/L | Waste Stream Liquid |
| Oil & Grease | < 0.01 mg/L | |
| Ammonia, N | 1,137 mg/L | |
| Thiophol | 68.5 mg/L | |
| Asbestos | 2.16 | |
| Antimony | N/A | |
| Boron | 3.23 | |
| Chromium | 0.13 | |
| Chromium | 4,419 | |
| Lead | 6.35 | |
| Manganese | 1.55 | |
| Mercury | 20.65 | |
| Selenium | 0.82 | |
| Silver | 2.58 | |
| Copper | 144.5 | |
| Molybdenum | 1.29 | |
| Zinc | 9.29 | |
| Heating Value | N/A | |
| Ignitability | N/A | |
| Corrosivity | Waste is Not Corrosive, per 75.261 g 3. | |
| Reactivity | Waste is Not Reactive, per 75.261 g 4. | |
| Total Organic Halogens | N/A | |
| PCP | 300 | |
| TDS | N/A | |

Date: 2/25/82

Analyst's Signature:

D. E. Enton

TITLE: TREATMENT COSTS
Backup Calculations

PROJECT NO.: 85-005
PROJECT NAME: WMP-AFPS9

PAGE 1
OF 3

ACID PLATING WASTE TREATMENT SYSTEM

1. CAPITAL COSTS

| | |
|-----------------------------|--------------------------------|
| 1,000 GAL BATCH TANK - TANK | - \$1000 |
| 2 CEMENTIC TANKS | - 500 |
| 2 FEED PUMPS | - 1000 |
| MIXER | - 500 |
| PIPING & AUXILIARY | - <u>2000</u> <u>\$5000</u> |
| INSTALLATION (50%) | 2500 |
| ENGINEERING (10%) | 500 |
| CONTINGENCY (15%) | <u>750</u> <u>\$2750</u> |

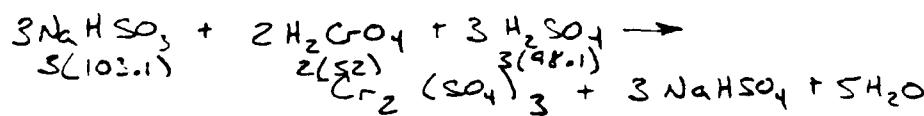
2 PERSONNEL

$$\text{ON-SITE} = 40 \text{ BATCHES} \times 8 \text{ hrs/BATCH} \times \$25/\text{hr} = \$8000/\text{yr}$$

$$\text{OFF-SITE} = 8 \text{ SHIPMENTS} \times 2 \text{ hrs/shipment} \times \$25/\text{hr} = \$400/\text{yr}$$

3. CHEMICALS

BASED ON 5000 ppm Cr⁶⁺



$$15\% \text{ NaHSO}_3 \text{ SODA} = 1\text{lb/gal}$$

$$93\% \text{ H}_2\text{SO}_4 \text{ SODA} = 14.2 \text{ lb/gal}$$

CHEMICAL DEMAND:

$$\text{Cr}^{6+} = \frac{5000 \text{ mg}}{\ell} \left| \frac{39800 \text{ gal}}{\ell} \right| \frac{3.79 \ell}{\text{gal}} \left| \frac{1\text{b}}{454,000 \text{ mg}} \right| = 1660 \text{ lb/yr.}$$

$$\text{NaHSO}_3 : \text{Cr}^{6+} = \frac{3(103.1)}{2(52)} = 3 \text{ lb NaHSO}_3 / \text{lb Cr}$$

$$\text{NaHSO}_3 \text{ DEMAND} = 3 \times 1660 \text{ lb/yr.} = 4980 \text{ lb NaHSO}_3 / \text{yr}$$

BY: B. BURGHER
DATE: 8-16-85

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TITLE:

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$$\text{H}_2\text{SO}_4 : \text{H}_2\text{O} = \frac{3(98.1)}{2(52)} = 2.8 \text{ lb H}_2\text{SO}_4/\text{lb Cr}$$

USE 100% STOICHIOMETRIC AMNT.

$$\text{H}_2\text{SO}_4 \text{ DEMAND} = 2 \times 2.8 \times 1660 = 9300 \text{ lb H}_2\text{SO}_4/\text{yr}$$

NaOH DEMAND



$$\text{NaOH : Cr} = \frac{6(40)}{2(52)} = 2.3 \text{ lb NaOH/lb Cr}$$

4.6 lb 50% NaOH/lb Cr

$$\text{NaOH DEMAND} = 4.6 \times 1660 = 7600 \text{ lb NaOH/yr.}$$

CHEMICAL DEMAND

| | | |
|--------------------------------|--------------------------|-------------|
| NaHSO ₃ | 4980 lb/yr @ \$0.2905/lb | = \$1450 |
| H ₂ SO ₄ | 9300 lb/yr @ \$0.0684/lb | = 640 |
| NaOH | 7600 lb/yr @ \$0.0358/lb | = 270 |
| | | \$2400 /yr. |

A. ANALYSIS COSTS

$$40 \text{ BATCHES} \times \$100/\text{SAMPLE} = \$4000/\text{yr}$$

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5. Sludge Production

$$\text{Cr(OH)}_3 : \text{Cr} = \frac{2(103)}{2(52)} = 1.98 \text{ lb Cr(OH)}_3 / \text{Cr}$$

$$\text{Sludge} = 1.98 \times 1660 \text{ lb/yr} = 3300 \text{ lb dry sludge/yr}$$

Assume sludge conc. of 2% solids

$$\text{Volume} = \frac{3300 \text{ lb dry sludge}}{0.02 \text{ dry}} \left| \begin{array}{c} \text{wet sludge} \\ \hline \end{array} \right| \left| \begin{array}{c} \text{gal} \\ 8.34 \text{ lb} \end{array} \right.$$

$$\text{Volume} = 19800 \text{ gal/yr. (165,000 lb/yr)}$$

Assume
 DISPOSAL COST = FRONTIER'S NEUT. CHROMIC ACID
 COSTS OF \$ 0.058/lb.
 + \$ 9.60/drum

$$\text{Costs} = 165,000 \text{ lb} \times \$ 0.058/\text{lb.} = 9570$$

$$+ \frac{19,800 \text{ gal}}{50} \times \$ 9.6 = 3850$$

$$\text{TOTAL} = \$ 13420$$

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PLANT # 59
OPERATOR: GE
DATE: 6-26-85

**WASTE MINIMIZATION PROGRAM
DATA SHEET**

WASTE STREAM: 7. PLATING RINSE WATER

CHARACTERISTICS: WATER AND JAPOL METAL & SALT
CONTAMINANTS. SEE ANALYSIS ATTACHED

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/ MANAGEMENT: RINSE WATER IS SURFACED RINSE TANKS TO
TRENCH SYSTEM WHICH FLOWS TO UNTREATED RINSEWATER
TANK. ON DEMAND RINSEWATER IS TREATED IN ION EXCHANGE
SYSTEM INCLUDING CATION & ANION EXCHANGE. DEONIZED WATER
IS STORED IN 5000 U/G TANK AND REUSED IN RINSE TANKS.
THE IX SYSTEM HAS BEEN OPERATIONAL SINCE

GENERATION 1. RATE: 8.1×10^6 GPY RECYCLED (250,000 GPY TREATED WASTE
 2. FREQUENCY: CONTINUOUS DISCHARGED TO #001.)
 3. COST: \$12,000 @ \$0.67/1000 GAL GENER CHARGES
\$ 1.48/1000 GAL TREATMENT COST
(ALSO SEE COST FOR REGEN & BWASH DISPOSAL, NOT INCL.
IN THIS FIGURE)

PROPOSED CHANGES: NONE

PROPOSED CHANGES: None

(ALSO SEE COST FOR REGEN & BWASH DISPOSAL, NOT INCL.
IN THIS FIGURE)

RAW MATERIAL DATA

1. CHARACTERISTICS: WATER
2. QUANTITY: 3 x 66 GPM
3. COST: \$0.66 / 1000 GAL

NOTES: 1. PRIOR TO IX SYSTEM, RINSEWATERS WERE TREATED
BY FLOC REDUCTION, PRECIPITATION & SETTLING FOR DISCHARGE TO
#001.
2. COSTS OF IX SYSTEM ARE ESTIMATED TO BE \$28,700

@ \$0.67 /1000 GALS SEWER CHARGE

\$ 2.92 /1000GAL TREATMENT COSTS

GENERAL ELECTRIC CO.
BINGHAMTON, NY
CHARACTERIZATION RESULTS
TREATMENT PLANT INFLUENT (DISCRETE SAMPLES)
TOTAL CHROMIUM (MG/L)

| <u>Date</u> | <u>Time</u> | <u>Concentration</u> |
|-------------|-----------------------|----------------------|
| 9/14/83 | 0738 | 0.26 |
| | 1032 | 0.82 |
| | 1612 | 0.29 |
| 9/15/83 | 0736 | 0.16 |
| | 1058 | 1.4 |
| | 1610 | 0.28 |
| 9/16/83 | 0735 | 0.13 |
| | 1025 | 0.17 |
| | 1615 | 0.21 |
| 9/19/83 | 1630 | 0.21 |
| | 0740 | 0.06 |
| | 1125 | 0.87 |
| 9/20/83 | 1612 | 0.51 |
| | 0750 | 0.19 |
| | 1025 | 0.20 |
| 9/30/83 | 1614 | 0.25 |
| | Average Concentration | 0.38 |

GENERAL ELECTRIC CO.
BINGHAMTON, NY
CHARACTERIZATION RESULTS
TREATMENT PLANT INFLUENT COMPOSITE

| <u>Parameter</u> | <u>Concentration</u> <u>(mg/l)*</u> | <u>Parameter</u> | <u>Concentration</u> <u>(mg/l)</u> |
|------------------|--|------------------|---------------------------------------|
| Cations | | | Heavy Metals |
| Calcium | 86 | Chromium | 0.23 |
| Magnesium | 14 | Lead | LT 0.01 |
| Sodium | 24 | Copper | 0.05 |
| Potassium | 1.9 | Nickel | 0.03 |
| Ammonia | 0.61 | Tin | LT 0.05 |
| Iron | 12 | Silver | LT 0.01 |
| Aluminum | 1.3 | | |
| Anions | | | |
| Chloride | 38 | | |
| Sulfate | 79 | | |
| Fluoride | 1.1 | | |
| Nitrate | 3.0 | | |
| Silicate | 3 | | |
| Phosphate | 0.02 | | |
| Bicarbonate | LT 0.5 | | |
| Other | | | |
| pH* | 7.2 | | |
| TDS | 370 | | |
| TOC | 3 | | |
| Total Alkalinity | 152 | | |
| TSS | 40 | | |

* pH in S.U.
LT = Less Than



PLANT # 59
OPERATOR: GE
DATE: 6-26-85

WASTE MINIMIZATION PROGRAM
DATA SHEET

WASTE STREAM: B. ION EXCHANGE SYSTEM WASTE

CHARACTERISTICS: WASTE WATER WITH METAL SALTS, SOLIDS
& REGENERATION SOLNS (H₂SO₄, NaOH)

(ATTACH ANALYSIS IF AVAILABLE)

SOURCE/MANAGEMENT: IX RESINS ARE BACKWASHED TWICE PER WEEK (400GAL/WASH)
AND REGENERATED MORE THAN ONCE PER MONTH (1600GAL/CYCLE)
REGEN & BACKWASH WATERS ARE COLLECTED IN
THE ACID WASTE HOLDING TANK AND TREATED WITH
WASTES BY WASTE CONVERSION INC

GENERATION 1. RATE: 40000 GPY; REG.
 2. FREQUENCY: 2/wk; 1/mo
 3. COST: \$28,100 (@ \$0.034/# + \$900/TRUCKLOAD TRNS)

PROPOSED CHANGES: EXPECT BACKWASH & REGEN. TO DECREASE
AS OPERATIONS BECOME BETTER KNOWN. ORIGINAL DESIGN
ESTIMATES WERE FOR 2 REGEN CYCLES PER YEAR

RAW MATERIAL DATA 1. CHARACTERISTICS: REGEN. CHEMICALS - H₂SO₄ & NaOH
 2. QUANTITY: ~ 9200 GPY NaOH & 2000 GPY H₂SO₄
 3. COST: 66°Be 4%

NOTES: _____

TITLE: ION EXCHANGE
CALCULATIONS

PROJECT NO.: 85-005
PROJECT NAME: AFP 55 WMP

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OF 3

ANION EXCHANGER

$$\text{eq. } \text{CrO}_4^{2-} = \frac{1 \text{ mg}}{\ell} \left| \begin{array}{c} \text{mmol} \\ 116 \text{ mg} \end{array} \right| \frac{2 \text{ meq}}{\text{mmol}} = 0.017 \text{ meq/l}$$

$$\text{TOT EQ / DAY} = \frac{0.017 \text{ meq}}{\ell} \left| \begin{array}{c} 3.78 \ell \\ \text{gal} \end{array} \right| \frac{3.1 \times 10^6 \text{ gal}}{\text{yr}} \left| \begin{array}{c} \text{yr} \\ 250 \text{ days} \end{array} \right| = 2.1 \text{ eq/day}$$

AT REGENERATION RATE OF 7 lb NaOH / CF RESIN

$$\text{OPERATING CAPACITY} = 0.71 \text{ eq./liter}$$

AT 2 GPM / CF LOADING RATE
AND 35 CF VOLUME

$$\text{COLUMN CAPACITY} = \frac{0.71 \text{ eq}}{\ell} \left| \begin{array}{c} 28.3 \ell \\ \text{ft}^3 \end{array} \right| \frac{35 \text{ ft}^3}{\text{cf}} = 703 \text{ eq.}$$

$$\text{OPERATING TIME} = \frac{703 \text{ eq}}{2.1 \text{ eq}} = 335 \text{ days.}$$

SIMILAR TO O'BRIEN & GEKE ESTIMATE OF 219 DAYS

REGENERATION VOLUMES / CYCLE

$$4\% \text{ NaOH} = \frac{7 \text{ lb NaOH}}{\text{cf}} \left| \begin{array}{c} 35 \text{ cf} \\ \text{cf} \end{array} \right| \frac{\text{gal}}{0.348 \text{ lb}} = 704 \text{ gal.}$$

$$\text{RINSE WATER} = \frac{50 \text{ gal}}{\text{cf}} \left| \begin{array}{c} 35 \text{ cf} \\ \text{cf} \end{array} \right| = 1750 \text{ GAL}$$

ASSUMING REGENERATION IS REQUIRED 3 TIMES / yr.

$$\text{WASTE GENERATION} = 3 \times 2454 = 7400 \text{ GAL/YR.}$$

BY: B. BURGESS
DATE: 8-16-85

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CATION EXCHANGE

CATION EQUIV CONC.

$$Ca^{2+} = \frac{86 \text{ meq}}{2} \left| \begin{array}{c} \text{mol} \\ 40 \text{ meq} \end{array} \right| \frac{2 \text{ meq}}{\text{mol}} = 4.3 \text{ meq/l}$$

$$Mg^{2+} = \frac{14}{24.3} \left| \begin{array}{c} 1 \\ 24.3 \end{array} \right| 2 = 1.2$$

$$Na^+ = \frac{24}{23} \left| \begin{array}{c} 1 \\ 23 \end{array} \right| 1 = 1.0$$

$$K^+ = \frac{1.9}{39} \left| \begin{array}{c} 1 \\ 39 \end{array} \right| 1 = 0.05$$

$$Fe^{3+} = \frac{12}{55.8} \left| \begin{array}{c} 3 \\ 55.8 \end{array} \right| 3 = 0.6$$

$$\underline{7.2 \text{ meq/l} \sim 8 \text{ meq/l}}$$

$$\text{TOTAL /DAY} = \frac{8 \text{ meq}}{1 \text{ gal}} \left| \begin{array}{c} 3.78 \text{ l} \\ 1000 \text{ meq} \end{array} \right| \frac{\text{eq}}{250} \left| \begin{array}{c} 8.1 \times 10^6 \\ 250 \end{array} \right| = 1000 \text{ eq/day}$$

$$\text{RESIN CAPACITY} = \frac{2 \text{ eq}}{1 \text{ l}} \left| \begin{array}{c} 28.3 \text{ l} \\ 8 \text{ ft}^3 \end{array} \right| \frac{35 \text{ ft}^3}{\text{gal}} = 2000 \text{ eq}$$

$$\text{OPERATING TIME} = \frac{2000 \text{ eq}}{1000 \text{ eq}} \left| \begin{array}{c} \text{day} \\ \text{day} \end{array} \right| = 2 \text{ days}$$

REGENERATION VOLUMES

$$66^\circ \text{ Brine H}_2\text{SO}_4 = \frac{6 \text{ lb}}{CF} \left| \begin{array}{c} 35 \text{ CF} \\ 14.2 \text{ lb} \end{array} \right| \frac{\text{gal}}{\text{gal}} = 15 \text{ gal/cycle}$$

$$@ 125 \text{ cycles} \times 15 \text{ gal/cycle} = 1900 \text{ gal/yr.}$$

$$\text{RINSE} = \frac{10 \text{ gal}}{CF} \left| \begin{array}{c} 35 \text{ CF} \\ 125 \end{array} \right| = 44,000 \text{ gal/yr.}$$

| | | |
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TOTAL WASTE GENERATION EST.

REGENERATION = 5000 gal/yr

RINSE WATER = 50,000 gal/yr

| | | |
|--------------|----------------------|-------------------------------------|
| BY: DATE: | CHECKED BY: DATE: | The Earth Technology Corporation |
|--------------|----------------------|-------------------------------------|

END

DATE

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